PROYECTO DE INNOVACIÓN DOCENTE

ATENCIÓN A LA DIVERSIDAD EN LAS TITULACIONES ADAPTADAS AL RD 1393/2007: ADAPTACIÓN DE UNA HERRAMIENTA WEB DE AUTOEVALUACIÓN CURRICULAR BASADA EN LAS PRINCIPIOS DEL DISEÑO UNIVERSAL PARA EL APRENDIZAJE

REFERENCIA: ID10/127

Participantes:

Emiliano Díez (Investigador Principal), Sergio Sánchez, Miguel Ángel Verdugo, Ana iglesias, Isabel Calvo

Instituto Universitario de Integración en la Comunidad

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Tabla de Contenidos

Introducción

La Ley Orgánica 2/2006 de Educación, de 3 de mayo, establece en su Artículo 1, Principios, como primer objetivo “la calidad de la educación para todo el alumnado, independientemente de sus condiciones y circunstancias”. De igual manera en segundo lugar establece que “la equidad, que garantice la igualdad de oportunidades, la inclusión educativa y la no discriminación y actúe como elemento compensador de las desigualdades personales, culturales, económicas y sociales, con especial atención a las que deriven de discapacidad”. Por ello, la necesidad de disponer de currículums accesibles que contemplen la posibilidad de cualquier tipo de alumnado dentro de las aulas debería ser un aspecto prioritario en el proceso de construcción de los mismos.

En primer lugar, en cuanto a la definición de los objetivos de un título oficial, se especifica que “los objetivos generales deberán definirse teniendo en cuenta los derechos fundamentales y de igualdad de oportunidades entre hombres y mujeres, los principios de igualdad de oportunidades y accesibilidad universal de las personas con discapacidad y los valores propios de una cultura de la paz y de valores democráticos”.

La adopción de concepciones abiertas e inclusivas respecto al modo de diseñar servicios y dispositivos, lo que algunos han denominado como corriente del *diseño universal* o *diseño para todos*, es un aspecto clave en relación con el incremento en la participación de las personas en situación de desventaja. Desde la corriente del diseño universal se propone el diseño de productos y entornos de fácil uso para el mayor número de personas posible, sin la necesidad de adaptarlos o rediseñarlos de una forma especial. Por tanto, el propósito del diseño universal es simplificar la realización de las tareas cotidianas mediante la construcción de productos, servicios y entornos más sencillos y más fáciles de utilizar por parte de TODAS las personas, con independencia de su género, edad, condición o habilidad.

De especial importancia en el ámbito educativo es la perspectiva del diseño universal aplicada a los entornos de aprendizaje: el Diseño Universal para el Aprendizaje (DUA). El DUA extiende la filosofía del diseño universal a los espacios pedagógicos, proponiendo un nuevo enfoque de enseñanza, aprendizaje y evaluación basado en los avances sobre el aprendizaje y las nuevas tecnologías para responder a las diferencias individuales en los estudiantes (Rose y Meyer, 2000). A través del diseño de currículo, métodos y políticas de enseñanza flexibles se apoyan las diferencias individuales en aprendizaje y se reducen las demandas de los educadores para el desarrollo e implementación de modificaciones y adaptaciones curriculares a posteriori (significativas y no significativas). A grandes rasgos, se trata de ofrecer alternativas en los materiales, los contenidos, los contextos y las tecnologías con el fin de beneficiar a todos los estudiantes, y no sólo a aquellos en situación de desventaja o discapacidad (Rose, Meyer y Hitchcock, 2005).

La filosofía del Diseño Universal para el Aprendizaje se basa en la aplicación de una serie de principios que fueron heredados del diseño universal arquitectónico y de productos y que con el tiempo se han complementado con otras perspectivas como la desarrollada por el Center for Applied Special Technology (CAST).

Además de ser el principal agente de difusión de la filosofía del diseño universal para el aprendizaje, el Center for Applied Special Technology ha desarrollado en los últimos años un gran número de publicaciones, entre las que destaca las Pautas de los Principios del Diseño Universal para el Aprendizaje. Dichas pautas desarrollan los tres grandes principios formulados por CAST para promover el Diseño Universal en los contextos de aprendizaje, además de incluir una serie de recomendaciones prácticas sobre las medidas que ayudan a implementar los principios y la evidencia científica que avala la eficacia de cada uno de ellos.

De manera paralela, desde el Center for Applied Special Technology se han venido desarrollando diferentes herramientas de enseñanza y de evaluación, siempre con el objetivo de hacer más visibles todos los temas relacionados con el diseño universal para el aprendizaje. De interés para el objetivo general de este proyecto ha sido la herramienta on-line que permite a cualquier profesional de la educación realizar un chequeo sobre el grado de ajuste de un diseño curricular a los principios del diseño universal para el aprendizaje. La herramienta, denominada UDL Curriculum Self-Check, permite, mediante una sencilla interfaz Web, autoevaluar diferentes aspectos relacionados con el diseño curricular de una lección o unidad de aprendizaje (objetivos, contenidos, metodologías, recursos y evaluación) y además proporciona un fácil acceso a información relacionada con cada elemento de evaluación.

Cumplimiento de objetivos

El principal interés de este proyecto se ha centrado en el desarrollo de una herramienta Web que permita a los docentes universitarios autoevaluar diferentes aspectos relacionados con el diseño curricular de una lección o unidad de aprendizaje siguiendo los principios del diseño universal para el aprendizaje desarrollados por el Center for Applied Special Technology.

De igual manera, el proyecto ha permitido crear una página Web con recursos de interés sobre Diseño Universal para el Aprendizaje. El objetivo final es difundir la filosofía del diseño universal para el aprendizaje como medio para ajustar los diseños curriculares a las situaciones de diversidad y así promover el ajuste de los nuevos títulos a la normativa vigente desde una perspectiva transversal.

Módulo 0. Revisión bibliográfica

En primer lugar, se planteaba la realización de una consulta en bases bibliográficas especializas para compilar un dossier documental y construir una base de datos de trabajos científicos, informes y otros documentos de interés sobre temática del Diseño Universal para el Aprendizaje (DUA). Esto constituía unos de los principales objetivos del proyecto.

Para ello se llevo a cabo una búsqueda bibliográfica en las principales bases de datos en las que se indexan trabajos científicos e informes en el campo de las ciencias sociales: PSYCINFO, ERIC y ProQuest Dissertations & Theses.

La búsqueda se realizó con el término de búsqueda “universal design” AND “learning”, combinación que corresponde a la denominación habitual en inglés del Diseño Universal para el Aprendizaje. También se realizó una búsqueda en castellano, aunque los resultados no fueron significativos en cuanto al volumen y/o relevancia de los documentos encontrados.

En la Tabla 1 se resumen los resultados de la búsqueda bibliográfica una vez eliminados registros duplicados y aquellos que no coincidían exactamente con la temática del diseño universal para el aprendizaje o que lo trataban de manera tangencial.

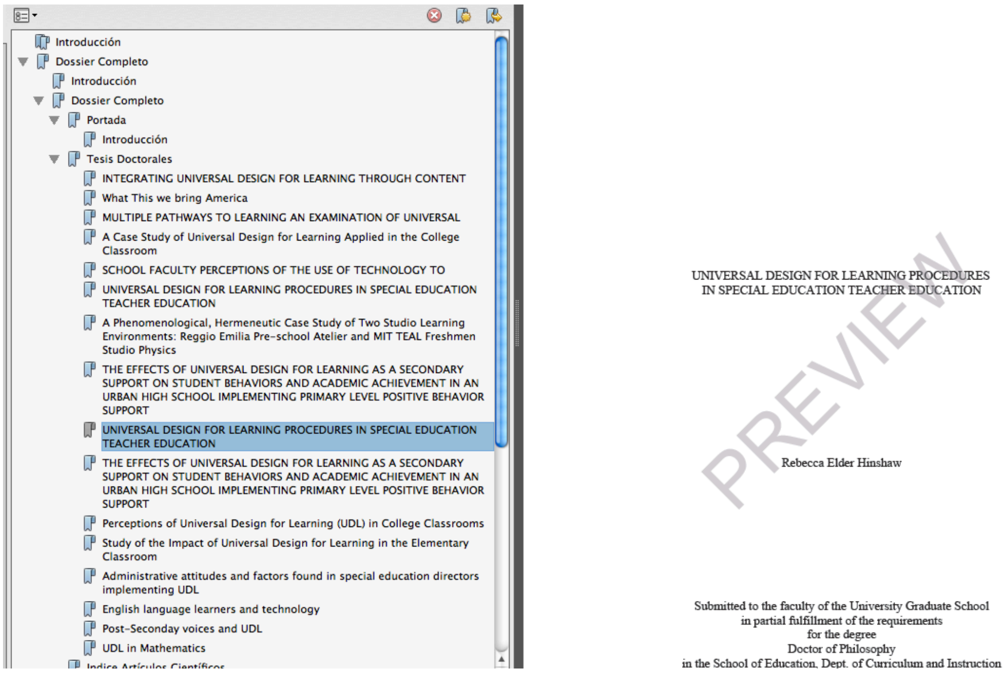
Tabla 1. Resultados búsqueda bibliográfica "Universal Design for Learning"

Tipo de Documento	Total
Artículos	50
Tesis	13
Capítulos de libro	1
Conferencias	1
Documentos Gubernamentales	1

Cómo se puede apreciar en la tabla 1, en total se encontraron 66 documentos. No obstante, el acceso a un número limitado de revistas científicas en este campo a las que se tuvo acceso a través de las suscripciones bibliográficas de la Universidad de Salamanca, sólo permitió poder obtener un número limitado de artículos a texto completo. Con los resultados de esta búsqueda bibliográfica se construyó una base de datos mediante EndNote X3 con el objetivo de crear un dossier documental sobre "Universal Design for Learning" (véase Anexo I).

En la parte final de este documento electrónico se puede consultar el dossier documental. Es posible navegar por sus contenidos a través de los marcadores incluidos en el documento PDF (accesible desde la opción de marcadores de Adobe Acrobat).

Figura 1. Acceso a los marcadores del dossier documental



Módulo 1. Creación de la aplicación web para la autoevaluación del ajuste a los principios del diseño universal para el aprendizaje

Diseño y creación de la aplicación de autoevaluación

Para diseñar la herramienta de autoevaluación y la aplicación web propuesta en el proyecto se ha partido, a modo de ejemplo y guía para su creación, la herramienta denominada “Self Check Curriculum” del Center for Applied Special Techonology (CAST). La herramienta puede encontrarse en la siguiente dirección web: http://udlselfcheck.cast.org/. Esta aplicación, en formato de cuestionario de auto-evaluación, permite al usuario hacer una valoración acerca del cumplimiento de los principios del Diseño Universal para el Aprendizaje en el diseño curricular de una asignatura o lección.

En el caso de este proyecto de innovación educativa y dado que hay poco conocimiento sobre los principios del diseño universal para el aprendizaje en nuestra comunidad universitaria, la adaptación de la herramienta se realizó a partir de las Pautas (versión 2.0) del Diseño Universal para el Aprendizaje, publicada por el mismo centro, CAST, en Febrero de 2011. El objeto de utilizar las pautas como base para el diseño de la herramienta asegura que el usuario que realice una autoevaluación completa pueda obtener un conocimiento mucho más preciso de las pautas y principios del DUA.

En primer lugar se procedió a la traducción de las pautas originales por parte de los miembros del grupo de investigación de este proyecto de innovación docente. El documento final ha sido creado en colaboración con CAST, adaptando, en la medida de lo posible, los contenidos a nuestro sistema educativo. A partir de la traducción de las pautas se diseñó un cuestionario de autoevaluación que incluyera todas las categorías e ítems de las pautas originales.

Posteriormente, se procedió al diseño de una aplicación Web de acceso gratuita para dar acceso a la herramienta de autoevaluación. La aplicación, bautizada como **EvalDUA**, se ha alojado en los servidores del Instituto de Integración en la Comunidad (INICO) y está accesible a través de la siguiente URL: http://inico.usal.es/evaldua/.

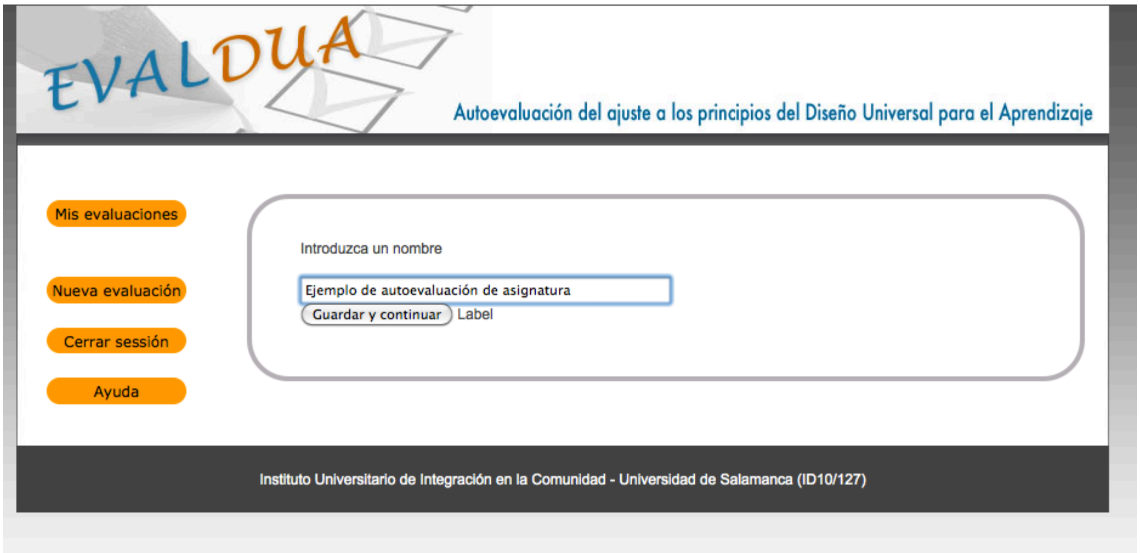
La Figura 2 muestra la pantalla de acceso de la aplicación con una breve presentación y las herramientas necesarias para darse de alta y poder acceder al cuestionario.

Figura 2. Página de acceso y de registro en EvalDUA (inico.usal.es/evaldua).

Una vez creada una nueva cuenta de usuario ya es posible acceder a la aplicación, desde la que se pueden realizar un número ilimitado de autoevaluaciones del ajuste de asignaturas o lecciones a los principios del diseño universal para el aprendizaje.

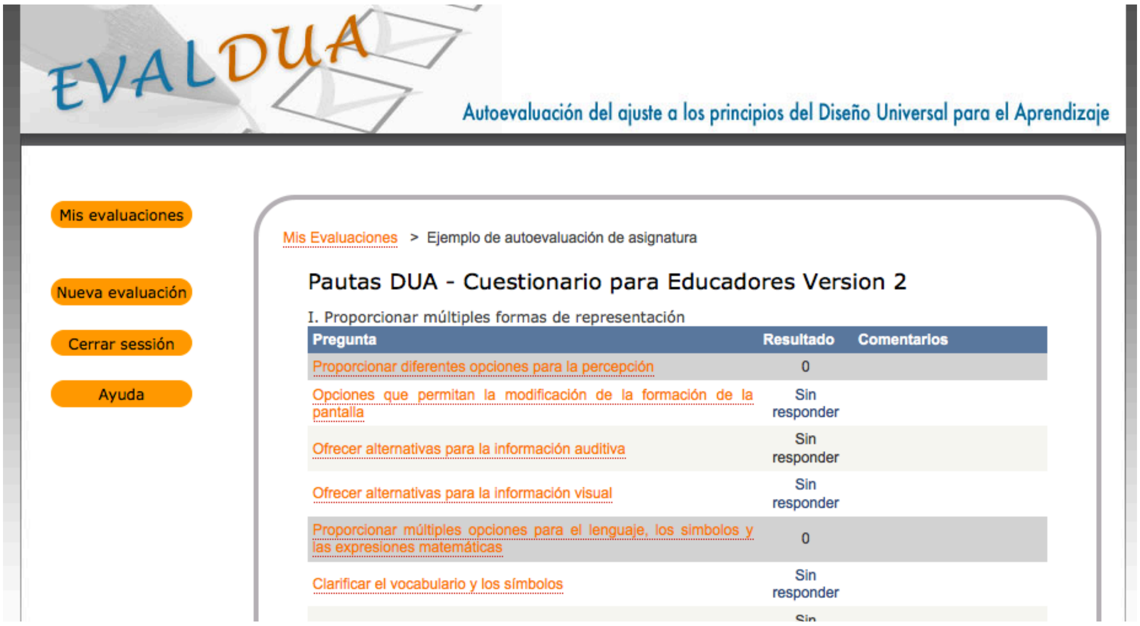
A través de la opción "Nueva Evaluación" es posible iniciar una nueva autoevaluación. Se debe dar un título a la evaluación y una vez guardado comenzará la navegación por los ítems que componen la autoevaluación

Figura 3. Creación de una evaluación



Tal y como se ha descrito anteriormente, los ítems de evaluación están organizados en función de los 3 grades principios del Diseño Universal para el Aprendizaje formulados por el Center for Applied Special Techonology (CAST) en la versión 2.0 de sus pautas. En todo momento es posible consultar dichos elementos de evaluación pulsando sobre la opción “categorías” en el menú de la aplicación. Esta opción da acceso a los elementos de evaluación (los tres principios, las categorías de evaluación y los ítems) y desde ella es posible navegar por los distintos elementos de evaluación.

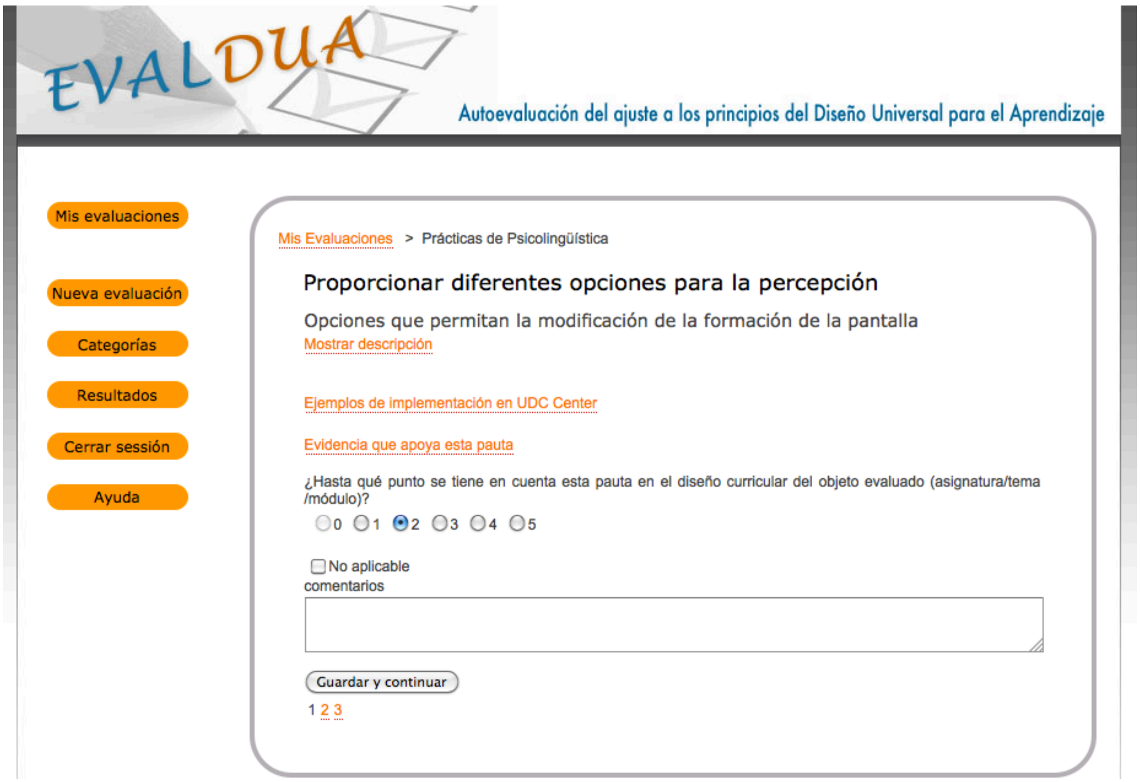
Figura 4. Elementos de evaluación



Para acceder a algún elemento de evaluación basta con pulsar sobre la categoría. Eso dará acceso a los elementos de evaluación de esa categoría. Tal y como muestra la Figura 5, cada pantalla de un elemento de evaluación contiene el nombre y la descripción de la categoría general y el ítem a evaluar y su descripción. También hay disponibles enlaces a información adicional en otros sitios Web de CAST sobre ese elemento de evaluación. En concreto enlaces a ejemplos de aplicación de la pauta/ítem y a fuentes de evidencia que apoyan el ítem/pauta. Por último, la pantalla da acceso a una escala de valoración que permite al usuario señalar el grado de ajuste del objeto curricular evaluado (asignatura, lección, etc.) a esa pauta concreta e introducir algún comentario sobre la valoración. También es posible señalar que esa pauta en concreto no es aplicable al objeto evaluado.

La pregunta de evaluación se ha formulado como **"¿Hasta qué punto se tiene en cuenta esta pauta en el diseño curricular del objeto evaluado (asignatura/tema/módulo)?"**, con una escala tipo Likert de 5 categorías de respuesta: 1 (nada), 2 (poco), 3 (algo), 4 (mucho) y 5 (totalmente)

Figura 5. Ejemplo de pantalla con elemento de evaluación

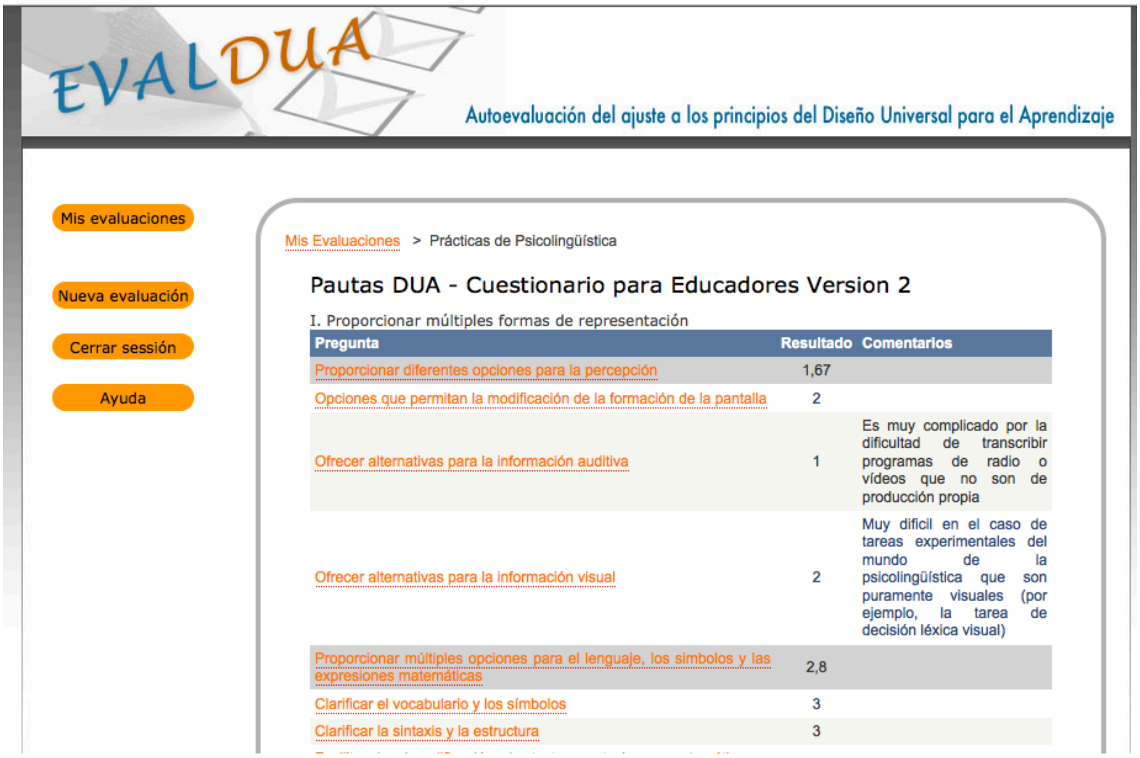


En todo momento es posible volver al explorador de evaluaciones a través de la opción del menú "mis evaluaciones" (véase Figura 6).

Figura 6. Explorador de evaluaciones

A medida que se van cumplimentando los distintos apartados de todas las categorías es posible visualizar los resultados a través de la opción "resultados" del menú. En la pantalla de resultados se muestran las puntuaciones de cada ítem/pauta así como el promedio de puntuación de cada categoría general de evaluación y de cada principio. También se muestran los comentarios realizados en cada ítem.

Figura 7. Pantalla de resultados de evaluación



Aplicación piloto de la herramienta de autoevaluación a las asignaturas del Proyecto

Una vez creada y puesta en marcha la herramienta de autoevaluación, el siguiente paso fue aplicar la herramienta a las asignaturas incluidas en el proyecto de innovación. En la Tabla 2 se muestran las asignaturas sobre las que los distintos miembros del proyecto han realizado una autoevaluación de ajuste a los principios del Diseño Universal para el Aprendizaje.

Tabla 2. Asignaturas incluidas en la aplicación piloto de la autoevaluación

Asignatura	Titulación
Actividades Ocupacionales Aplicadas	Diplomatura en Terapia Ocupacional
Rehabilitación de capacidades funcionales	Máster en Neuropsicología/Máster Universitario en Investigación sobre Discapacidad
Psicolingüística	Licenciatura en Psicología
Didáctica General	Grado en Educación
Psicología de la Discapacidad	Licenciatura en Psicología
Intervención Educativa	Diplomatura de Educación Social
Atención a la Diversidad	Máster Universitario de Educación Secundaria

Los responsables de estas asignaturas se encargaron de evaluar cada asignatura mediante EvalDUA para analizar hasta qué punto se seguían los principios del diseño universal para el aprendizaje en el diseño curricular de las mismas.

Los resultados globales de la autoevaluación, organizados en función de los tres principios del DUA se muestran en las siguientes tablas.

Tabla 3.Promedio de valoraciones del ajuste a las pautas del Principio I. Proporcionar múltiples formas de representación

	Valoración Media (1-5)
1. Proporcionar diferentes opciones para la percepción	**2.75**
1.1 Opciones que permitan la modificación de la información de la pantalla	3.25
1.2 Ofrecer alternativas para la información auditiva	2.50
1.3 Ofrecer alternativas para la información visual	2.50
2. Proporcionar múltiples opciones para el lenguaje, los símbolos y las expresiones matemáticas	**2.95**
2.1 Clarificar el vocabulario y los símbolos	3.00
2.2 Clarificar la sintaxis y la estructura	3.50
2.3 Facilitar la decodificación de textos, notaciones matemáticas y símbolos	2.75
2.4 Promover la compresión entre diferentes idiomas	1.75

2.5 Ilustrar a través de múltiples medios	3.75
3. Proporcionar opciones para la compresión	**4.25**
3.1 Activar o sustituir los conocimientos previos	4.50
3.2 Destacar patrones, características fundamentales, ideas principales y relaciones	4.25
3.3 Guiar el procesamiento de la información, la visualización y la manipulación	4.25
3.4 Maximizar la transferencia y la generalización	4.00
Promedio principio I	**3.32**

Tabla 4.Promedio de valoraciones del ajuste a las pautas del Principio II. Proporcionar múltiples formas para la acción y la expresión

	Valoración Media (1-5)
4. Proporcionar múltiples medios físicos	**2.50**
4.1 Variar los métodos de respuesta y navegación	2.75
4.2 Optimizar el acceso a las herramientas y los productos de apoyo	2.25
5. Proporcionar opciones para la expresión y la comunicación	**3.42**
5.1 Usar múltiples medios de comunicación	3.75
5.2 Usar múltiples herramientas para la construcción y composición	2.75
5.3 Construir competencias con niveles graduados de apoyo para la práctica y la ejecución	3.75
6. Proporcionar opciones para las funciones ejecutivas	**3.94**
6.1 Guiar el establecimiento de metas adecuadas	4.50
6.2 Apoyar la planificación y el desarrollo de estrategias	4.00
6.3 Facilitar la gestión de información y de recursos	3.75
6.4 Aumentar la capacidad para monitorizar el progreso	3.50
Promedio principio II	**3.28**

Tabla 5.Promedio de valoraciones del ajuste a las pautas del Principio III. Proporcionar múltiples formas de participación.

	Valoración Media (1-5)
7. Proporcionar opciones para captar el interés	**3.58**
7.1 Optimizar la elección individual y la autonomía	3.50
7.2 Optimizar la relevancia, el valor y la autenticidad	3.75
7.3 Minimizar las amenazas y las distracciones	3.50
8. Proporcionar opciones para mantener el esfuerzo y la persistencia	**3.88**
8.1 Aumentar la relevancia de las metas y los objetivos	4.25
8.2 Variar las demandas y los recursos para optimizar el desafío	4.00
8.3 Fomentar la colaboración y la comunidad	3.75
8.4 Incrementar el feedback orientado a la maestría	3.50

9. Proporcionar opciones para la auto-regulación		**3.08**
9.1 Promover expectativas y creencias que optimicen la motivación		3.00
9.2 Facilitar estrategias y habilidades de afrontamiento		2.75
9.3 Desarrollar la auto-evaluación y la reflexión		3.50
	Promedio principio III	**3.51**

La puntuación global de ajuste alcanzó un valor promedio de 3.37. Por tanto, las asignaturas evaluadas no mostraron un ajuste general demasiado alto a los principios del DUA. No obstante, la puntuación permite afirmar que, al menos, se tienen en cuenta la mayor parte de los principios, aunque no se apliquen de manera sistemática y total.

En cuanto a principios generales, aunque todas las puntuaciones promedio resultaron muy similares y de valores intermedios, el mejor ajuste se observó en relación al principio III (*M* = 3.51), seguido del principio I (*M* = 3.32) y por último el principio II (*M* = 3.28). Aunque los valores son muy similares parece que las mayores dificultades podrían tener que ver con aquellas pautas que inciden en que no hay un único medio de acción y expresión que sea óptimo para todos los estudiantes y que, por tanto, es indispensable proporcionar diversas opciones para la acción y la expresión. Algunos estudiantes pueden ser capaces de expresarse correctamente por escrito, pero no por vía oral, y viceversa. Además, debería tenerse en cuenta que la acción y la expresión requieren una buena cantidad de estrategias, práctica y organización, y esto es otra área en la que los estudiantes pueden diferir entre sí.

En cuanto a las puntuaciones por categorías cabe destacar la categoría que alcanzó una mayor puntuación promedio: Proporcionar opciones para la comprensión (*M* = 4.25) en la que se incluyen aspectos como la activación de los conocimientos previos, el destacar las ideas y relaciones principales o el énfasis en la transferencia y la generalización. Y también cabe destacar aquellas categorías con puntuaciones menores de 3. En concreto fueron las categorías relativas a las pautas: Proporcionar diferentes opciones para la percepción y Proporcionar múltiples medios físicos. Ambas categorías tienen que ver con las opciones más directamente relacionadas con la accesibilidad a la información y con aspectos que muchas veces están fuera del control del docente o para las cuales requiere de mucha ayuda con el objeto de adaptar herramientas o contenidos existentes a formatos que puedan ser accedidos por estudiantes con diversidad funcional (e.g., transcripción de vídeos para alumnos con discapacidades sensoriales o adaptación de herramientas informáticas para que sean compatibles con productos de apoyo como lectores de pantalla o sistemas de respuesta por barrido)

En general, aunque los resultados cuantitativos son importantes, lo más destacable en cuanto a la aplicación piloto de EvalDUA, y que fue señalado por todos los participantes en el proyecto, es el haber tenido la oportunidad de conocer más a fondo los principios del diseño universal para el aprendizaje y de reflexionar sobre su aplicación en el diseño curricular de sus asignaturas. Además, algunas de las asignaturas evaluadas eran asignaturas de planes de estudio a extinguir y, en estos casos, algunos participantes manifestaron su intención de considerar todos los principios del DUA en el diseño de sus nuevas asignaturas en los títulos de Grado o Máster.

En conclusión, el estudio piloto ha servido para demostrar la utilidad de la herramienta de auto-evaluación y para promover la reflexión sobre los principios del DUA entre los participantes en el proyecto.

Módulo 2. Creación de una página Web con información general sobre Diseño Universal para el Aprendizaje

Dentro del conjunto de acciones encaminadas a la difusión del Diseño Universal para el Aprendizaje y como uno de los objetivos del proyecto, se ha diseñado u sitio web complementario a la aplicación de auto-evaluación con recursos relacionados con el Diseño Universal para el Aprendizaje. El sitio está alojado en los servidores del Instituto Universitario de Integración en la Comunidad y se puede acceder a través de la URL: http://inico.usal.es/dua

Aunque es un sitio dinámico y se actualizará de manera periódica, los recursos incluidos actualmente proceden fundamentalmente de la recopilación documental realizada a partir de las bases de datos consultadas, de la propia página de CAST (http://www.cast.org), así como del Centro Nacional para el Diseño Universal para el Aprendizaje (http:// www.udlcenter.org). Para la sección de páginas webs, las bibliografías proporcionadas tanto en artículos como en tesis doctorales han conducido a la identificación de los principales centros universitarios, así como estados confederados estadounidenses, que tienen integradas e implementadas las políticas del Diseño Universal dentro de sus planes de estudio. Por último, para sección de vídeos, se han proporcionado los enlaces a los principales vídeos de difusión del Diseño Universal para el Aprendizaje, así como el propio canal de CAST dentro de Youtube.

Los recursos se han organizado en diferentes categorías: a) Tesis; b) Artículos; c) Páginas web; y d) Vídeos.

La siguiente figura muestra el resultado final en la página web.

Figura 8. Página principal de la web de recursos sobre Diseño Universal para el Aprendizaje (disponible en http://inico.usal.es/dua)

En la parte central de la página principal se muestran los últimos elementos introducidos y una selección de elementos destacados. En la parte izquierda un menú da acceso a todas las secciones de la Web y a la herramienta de autoevaluación. Y en la parte derecha se ha incluido una nube de tags y enlaces a los últimos documentos incluidos en la base de datos que alimenta la Web.

En cada registro se ha incluido toda la información relevante para acceder a la fuente original, para compartir el recurso a través de redes sociales y, en los casos en los que ha sido posible, también se ha incluido el documento o el recurso original. En la siguiente figura se muestra un ejemplo de cómo se visualiza una registro en detalle.

Figura 9. Detalle de registro en la Web de recursos sobre DUA

Conclusiones

Los objetivos que se plantearon para el desarrollo de este proyecto fueron, principalmente, de carácter aplicado y creemos que los resultados obtenidos podrían tener una clara utilidad práctica para todos aquellos profesionales interesados en la aplicación de los principios del Diseño Universal para el Aprendizaje en el diseño curricular. Esto incluye a profesores, orientadores y, en general, cualquier profesional relacionado con la educación de estudiantes con discapacidad y otras situaciones de desventaja.

En primer lugar, la aplicación de evaluación desarrollada contribuye a difundir los principios del DUA y promover la reflexión sobre su aplicación en un contexto educativo. Los resultados de la aplicación de *EvalDUA* a un “objeto curricular” (Asignatura, lección, práctica, etc.) facilitan el autoanálisis dirigido a la toma de medidas de cambio sobre un diseño curricular para que éste se ajuste a la diversidad de estudiantes que se observa en las aulas universitarias. En resumen, EvalDUA es una herramienta ideal para aprender sobre Diseño Universal para el Aprendizaje, evaluar un objeto curricular o simplemente explorar recursos e ideas sobre cómo integrar opciones y flexibilidad en los distintos elementos que configuran un curriculum.

En segundo lugar, el sitio Web con recursos sobre Diseño Universal para el Aprendizaje puede ser de gran interés general para la comunidad educativa ya que permitirá dar a conocer los principios de DUA así como ejemplos de buenas prácticas en la aplicación de esos principios y evidencia científica que apoya su uso en los contextos educativos.

Además, de manera indirecta, ambos desarrollos contribuyen a aumentar el conocimiento sobre los principios del diseño universal para el aprendizaje de sus usuarios y por tanto a promover cambios en el diseño curricular de las asignaturas/lecciones/prácticas evaluadas de cara a mejorar su ajuste a los principios y pro tanto a facilitar el acceso al curriculum a estudiantes con necesidades educativas diversas, principalmente a aquellos con discapacidad.

Igualmente, consideramos que los resultados de la aplicación piloto de la herramienta de autoevaluación podría servir como guía de buenas prácticas para otras asignaturas y titulaciones, y podrían utilizarse como ejemplo de medida positiva para la mejora de la calidad de las titulaciones en lo que se refiere al ajuste a la normativa vigente sobre la atención a la diversidad en el sistema educativo universitario.

Anexo I. Dossier documental de trabajos de investigación sobre Diseño Universal para el Aprendizaje

Dossier documental de trabajos de investigación sobre Diseño Universal para el Aprendizaje

Proyecto: Atención a la diversidad en las titulaciones adaptadas al RD1393/2007: Adaptación de una herramienta Web de autoevaluación curricular basada en los principios del diseño universal para el aprendizaje

Identificación del proyecto: ID10/127

INDICE

Introducción

El siguiente dossier documental presenta los principales documentos científicos sobre el Diseño Universal para el Aprendizaje (DUA).

El orden de presentación ha sido, en primer lugar, los resúmenes de las tesis doctorales que han tenido como eje fundamental en sus trabajos el DUA y han sido obtenidas en la base de datos Proquest Dissertations and Thesis, con un total de dieciséis tesis publicadas.

En segundo lugar se presentan los artículos más destacados sobre DUA publicados en las principales revistas de divulgación científica en áreas como la psicología, educación y discapacidad. El número total seleccionado para este dossier atendiendo a la relevancia de los artículos ha sido de treinta y cinco artículos.

Para presentar estos trabajos se ha optado por una opción dividida en dos partes. De este modo, la primera parte se presentan los artículos a los que se ha podido tener acceso en formato de texto completo y, en un segundo lugar, aquellos artículos en los que sólo se ha podido acceder a los resúmenes de los mismos.

Para el caso de los artículos las bases científicas utilizadas han sido la base de datos más utilizada en educación ERIC y una de las principales base de datos en psicología como es PsyInfo.

El orden de presentación en todos los trabajos, tanto tesis doctorales como artículos científicos, ha sido el mismo. En primer lugar se presentan los trabajos en orden cronológico comenzando por aquellos que son más recientes y dentro de este esquema, en cada año, se han ordenado de manera alfabética.

Tesis Doctorales

INTEGRATING UNIVERSAL DESIGN FOR LEARNING THROUGH CONTENT VIDEO WITH PRESERVICE TEACHERS

by

SARA ANN ARONIN

B.S., Bradley University, 2000
M.Ed., Cambridge College, 2004

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Child, Family, and Community Sciences
in the College of Education
at the University of Central Florida
Orlando, Florida

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2009

Major Professor: Lisa A. Dieker

ABSTRACT

Given current legislation to ensure education for students with disabilities and that institutions of higher education are required to use universal design for learning (UDL) principles, the purpose of this study was to explore the impact of video modeling on preservice teachers' knowledge, understanding and application of the three principles of UDL. Preservice teachers were randomly assigned to control or experimental groups to determine if video embedded with UDL principles impacted their thinking. Specifically, pre and posttest information of knowledge and understanding as well as self-perceived ability to teach students with disabilities using UDL was analyzed. In addition preservice teacher created lesson plans were analyzed for application of UDL principles after viewing the video intervention. Quantitative analyses were conducted to compare pre and posttest scores of the control group (n = 41) and experimental group (n =45). The quantitative analyses of knowledge, understanding and self-perceived ability to use UDL were mixed. The results of this investigation were consistent with current research that teacher application of a skill requires more than a one-shot intervention.

This dissertation is dedicated to all those who were told they could not accomplish something and did it anyway.

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I would like to thank several people who have assisted me in completing my PhD at UCF. I applied to UCF after meeting Dr. Wilfred Wienke at a conference in Hawaii, but attended this program at UCF because of the personal caring and support from all of the faculty and doctoral students through the application, admittance, courses, comprehensive exams, publications, and of course the dissertation processes.

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Dr. Wienke, I would like to thank you for your mentoring and support whether over watermelon or muffins. I value the opportunities you provided me through internships and conferences. Dr. Hines, you have been my constant source of wonderment, as before I met you I did not realize how far beyond my comfort zone it was possible to go. Thank you for teaching me to laugh at myself and that choice and UDL can not only improve education, but motivation and self-esteem.

I especially want to thank Dr. Lisa Dieker. Thank you for not only chairing my committee but for your role in my successes while in the program. Your "mentor moments," "gentle pushes," "reminders" and of course your friendship have allowed me to experience many wonderful aspects of our field. Thank you for your continued and constant support. You have been a wonderful role model that career and family are not only possible but important.

There are several people who have aided my completion of this dissertation. Thank you to Dr. Craig Berg for being on my committee and Dr. George Roy for allowing me to conduct research in your classes. Kimberly Pawling, Marissa Salazar, and Kelly Grillo, thank you for your support and assistance with the entire dissertation process. Da'Zhaun and Angell Hicks for helping me film. The "critics" fell in love with you making your narration all the more powerful.

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I want to thank my family, Phyllis, Eric, Jake, and Zachary Aronin for your support no matter what crazy decision I make. To my Zaide, who in 1982, at age 70, achieved his dream of earning a bachelor's degree, I thank you for instilling a love of learning.

I want to thank my Ohana and especially to Barbara Cooper for being a continuous part of this journey. From studying for the GRE, to flying with me to take it (staying in the Alice in Wonderland Room), to celebrating my admission, the countless hours of listening to me talk through a study or editing papers, and most importantly being a constant source of support, encouragement, and love. I thank you and I feel as though this is your degree as well.

More than ever, I wish to thank my loving husband, Michael O'Neal, who not only moved half way around the world to be with me but embraced our relationship with an abundance of love (and patience) allowing us to both be in school and get married at the same time. I thank you for your unvarying support and encouragement.

Finally, I would like to thank everyone who has taken me by the hand to not only tell me, but show me different ways to think, act, and teach. It is because of you that I want everyone to know about the empowerment of universal design for learning.

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CHAPTER ONE:
THE PROBLEM AND ITS CLARIFYING COMPONENTS

Introduction

Elementary teachers need to provide instruction that is designed to meet the needs of all students (Darling-Hammond, 2003). The field of special education currently is advocating that instruction be universally designed to meet a wide range of learners' needs in the general education setting (Hitchcock, Meyer, Rose, & Jackson 2002). Chapter one provides a rationale to address this issue by providing elementary preservice general education teachers instruction in the application of principles of universal design for learning (UDL) in lesson planning (Rose & Meyer, 2000; 2005). The chapter begins with the statement of the problem and a literature review comprised of legislative action that has led to the inclusion of students with disabilities in general education classrooms; and the resulting need for preservice teachers (PTs) to be prepared to develop goals, methods, materials, and assessments for students of varying ability levels. The chapter discussion then moves to the purpose of the study and the application to practice. The chapter concludes with a presentation of the methodology including research questions, design, data analysis, and definitions of terms.

Statement of the Problem

Many developments in the history of special education have led to unforeseen outcomes (Hallahan, Kauggman, & Pullen, 2009). As a result of recent changes to educational legislation, NCLB (2001) and IDEA (2004), have impressed upon educational institutions the importance of including all students in standards-based coursework in the least restrictive environment (LRE). Though data support including all students in general education classes (Gable, Hendrickson, &

Tonelson, 2000), research indicates that many general education preservice teachers (PTs) do not perceive themselves as adequately prepared to provide instruction to students who have disabilities (Kirch et al., 2007; Norman et al., 1998).

A potential solution is for higher education to better prepare all teachers for the range of students they will instruct. Higher education needs to help PTs reconceptualize the process from the teacher being engaged to students being the center of learning by creating multiple pathways for students' success (Bouillion & Gomes, 2001; McGregor, 2004; McGregor & Guner, 2001; Singer, Marx, Krajcik, & Clay-Chambers, 2000). Traditionally teachers have used the lecture-read-group discussion method in conjunction with a textbook to teach content material. These techniques for students with varying learning styles and abilities have not resulted in successful learning outcomes as noted in low graduation rates, high rates of unemployment and underemployment as well as limited post-secondary enrollment for students with disabilities (Horton, Lovitt, & Slocum, 1988). McCoy (2005) suggests that in order to develop and sustain student interest in content areas they need to be engaged in the process avoiding excessive textbook and lecture dependent learning. Unfortunately, according to the Trends in Mathematics and Science Study (TIMSS) data, fourth grade students noted this type of student-centered engaged learning is not occurring (Martin, Mullis, & Foy, 2007). The current findings indicate "the most frequent science investigation activities were writing, giving an explanation, and watching teachers demonstrate a science concept (69%)" (p. 296). In fact, internationally, 52% of fourth grade students noted textbooks as the primary source for science instruction (Martin et al.). These findings indicate a paradigm shift is needed for success of all students and perhaps even more critical for students with disabilities for reasons indicated.

A dramatic shift in teacher preparation and classroom practice needs to occur. The reauthorization of the Higher Education Act (2008) requires the use of UDL principles; multiple means of representation (MMR), multiple means of action and expression (MMAE), and multiple means of engagement (MME) for students with disabilities. One example is that recipients of federal grants relating to teacher preparation must include in the course work “strategies consistent with the principles of UDL” [P.L. 110-315, §300.172(a)(1)] and that preparation program evaluation and performance measures should include UDL (Sopko, 2009).

Since institutions of higher education (IHE) are required to use UDL principles in teacher preparation courses then logic would follow that PTs need to understand how to apply these practices in K-12 education. By applying UDL principles during planning, PTs may consider themselves more equipped to meet the needs of students with varying ability levels. Utilizing UDL in lesson planning requires a movement from teacher-centered classrooms to student-centered. Critical to this shift is PTs thinking about the presentation of academic material in a way that may be very different from how they were taught (Biddle, 2006; Lee et al., 2004). This change for teachers begins with a belief that positive learning outcomes for all students are possible (Haney, Czerniak, & Lumpe, 1996; Haney & McArthur, 2002) and by being prepared by IHE, to serve all students effectively.

Background: Need for Study

Previous generations of general education teachers often did not provide instruction to students with disabilities, and course work related to this population was only provided to special educators. The focus of these special education courses was to find and “fix” the student’s problems in an isolated environment restricting access to the general education environment

(Jackson & Harper, 2001). However, society has learned that education cannot “fix” a student as shown by the alarming statistics that 60% of inmates and 75% of unemployed adults are functionally illiterate and at least 33% of mothers on welfare have identified disabilities (Rumberger & Thomas, 2000).

On the other hand, as a result of No Child Left Behind (NCLB, 2001) and the Individuals with Disabilities Education Act (IDEA, 2004), special education is no longer a place for students with disabilities, but rather a system of supports and services allowing greater access to the general education curriculum (Jackson & Harper, 2001). The focus has changed from “fixing” the student to fixing the curriculum to meet the needs of students with varying ability levels. Consequently, general education teachers today are expected to plan lessons with the objective of students with disabilities accessing the general education curriculum (Jackson, Harper, & Jackson, 2001; Rose & Meyer, 2002). In order to accomplish the task of retrofitting the curriculum, general education teachers must reflect on their current practice and decisively explore how to make the learning more flexible for students of varying ability levels (Jackson & Harper).

Preservice teachers are in the process of learning instructional practices and developing their repertoire of lessons and therefore do not need to retrofit curriculum if given the opportunity to design flexible lessons from the start of their preparation program. By IHE building these skills into the PT curriculum this population will be well prepared to teach all students (Lipsky & Gartner, 2004).

Yet, the way general education teachers are currently prepared, and how they design lesson plans has not necessarily changed to account for inclusion of students with disabilities (Lipsky & Gartner). Preservice teachers tend to perceive themselves as lacking the necessary skills to plan appropriate instruction for students of varying ability levels (Kirch, Bargerhuff, Turner, & Wheatly, 2005; Norman, Caseau, & Stefanich, 1998). In fact, many PTs were themselves not in inclusive classes, a point of reference from modeling effective practices for students with disabilities in many cases is nonexistent (Ingersoll, 2003). However, the quandary remains of how PTs can change self-perceptions and obtain competency in planning instruction that utilizes research-based practices to meet students' various academic needs.

Universal Design for Learning (UDL)

One avenue by which educators can change their practice is by planning for inclusive classrooms through UDL. Universal design for learning is defined by the Center for Applied Special Technology (CAST) as "a framework for designing educational environments that enable all learners to gain knowledge, skills, and enthusiasm for learning… by simultaneously reducing barriers to the curriculum and providing rich supports for learning" (Center for Applied Special Technology [CAST], 2007, n.p.). Instead of having an accommodation for a single student, that accommodation now becomes an option for all learners. The underlying meaning behind UDL is to provide a proactive way of designing curriculum to meet individual learning needs by allowing for optimum content access for all students (Rose & Meyer, 2000). The model is designed for not simply accessing information or activities, but rather as a plan for learning that accounts for the abilities of all learners (Hitchcock et al., 2002). This plan typically consists of the three principles teachers consider as they develop their instruction (CAST, 2008); Principle I: provide multiple means of representation (the "what" of learning); Principle II: provide multiple means of expression (the "how" of learning); and Principle III: provide multiple means of engagement (the "why" of learning) (www.cast.org). By using the three principles of

UDL when writing lesson plans; the goals, methods, materials, and assessments of content are the focus of learning, not student differences. “The three principles of UDL have strong intuitive appeal when applied to the design of curriculum media and materials… [and] also have practical and ethical appeal in that application endeavors to increase instructional effectiveness, and simultaneously extend this effectiveness to all learners” (Jackson & Harper, 2001, p. 7). When educators change their practice by utilizing UDL, they are inherently planning for inclusion.

Purpose of the Study

The purpose of this study is to contribute to the existing field of resources regarding teachers’ self-perceptions of competency in planning lessons for students of varying ability levels using UDL. The study explores preparing general education preservice elementary teachers to plan for students of varying ability levels by understanding and applying UDL principles. The unique contribution this study explores is if teaching UDL through video in the content area of science influences the application and perceptions of PTs to meet the needs of a wide range of learners.

Application to Practice

This study attempts to determine the effects of video instruction in UDL on PTs knowledge, perceptions, and lesson development. As a result of learning about UDL in a content area, the researcher hypothesizes that PTs will improve their perceptions for teaching a wide range of learners as well as improve their knowledge and understanding of UDL.

Research Questions

The following research questions were investigated with PT:

1. Does knowledge and comprehension of universal design for learning principles change when taught in context with content?
2. Does preservice teachers' perception about their ability to serve students with disabilities change when provided video intervention with universal design for learning?
3. Does application of universal design for learning principles increase when taught in context with content?

Instrumentation

Two instruments were used for data collection in the study, a researcher designed pre and posttest and a lesson plan evaluation tool. The pre and posttest were used to measure knowledge and understanding of UDL principles as well as PTs' self perceived levels of competency to teach students of varying ability levels using the three principles and nine guidelines of UDL. The lesson plans created by the PTs were used to measure the application of UDL principles.

Pre and Posttest

The pre and posttest (see Appendix A) were developed by the researcher with assistance and use of questions provided by the CAST center. This instrument was developed to examine knowledge/ understanding about UDL and perceptions of competency to teach students of varying ability levels. The pre and posttest consisted of ten sections measuring knowledge and comprehension of UDL as well as self-perceptions and science content knowledge. Section one of the instrument related to participants' rights as stated in the approval of the Institutional Review Board (IRB) (see Appendix B for IRB approval and Appendix C for consent forms) while section two provided a place for the participant number. To measure PTs knowledge of UDL, section three had twelve multiple-choice questions, and one question where the respondents choose three of nine items provided. Section four had four open-ended questions that measured comprehension of the UDL principles. Additionally, section five consisted of 13 questions rating self confidence of teaching students of varying ability levels on a five-point Likert scale, with one being the lowest perception of competency and five being highest perception of competency. The pretest had the exact same questions as the posttest with four additional questions relating to demographics as section six of the pretest. These four demographic questions were not repeated on the posttest since participant demographics would not have changed during the course of the study. Both the pre and posttest were accessed through surveymonkey.com, an online secure data collection website, or via a paper copy of the survey.

Lesson Plan

Participants were asked to create a standard lesson plan as part of a class assignment (see Appendix D). Specifically, PTs were asked to write a lesson plan including sections for materials, procedures, and assessments using UDL to accommodate students with varying ability levels. The PTs framed their lessons using three tools; a given state standard, the three components of UDL, and the science content from a two-minute Brainpop video used as a component of the study. Data from the lesson plans were analyzed using a 3-point scale rubric (0 = no response, 1 = undeveloped, 2 = partially developed, 3 = fully developed) to determine if

WHAT THIS IS WE BRING YOUR AMERICA:

THE CO-CONSTRUCTION OF AN ELECTRONIC PICTUREBOOK

BY SPECIAL EDUCATORS AND THEIR STUDENTS ACCORDING TO

THE PRINCIPLES OF UNIVERSAL DESIGN FOR LEARNING

John Francisco Fitzgerald

A DISSERTATION

in

Teaching, Learning and Curriculum

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Supervisor of Dissertation:

Jeanne M. Vissa

Jeanne Vissa, Adjunct Professor of Education

Dean, Graduate School of Education:

A C Porter

Andrew C. Porter, Dean

Dissertation Committee:

Jeanne Vissa, Adjunct Professor of Education
Lawrence Sipe, Professor of Education
Joan Myers, Professor of Education

What This Is We Bring Your America:
The Co-Construction of an Electronic Picturebook
by Special Educators and Their Students According to
the Principles of Universal Design for Learning

Dedicación

Para mi esposa bella Jesenia y mi hija preciosa Yereimy
¿Quién tiene más paciencia que ellas?

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For their encouraging words when I first began to explore the application of Freirean pedagogy in Special Education settings I wish to thank Dr. Dale Snauwaert and Dr. Elaine Atkins. For the generous amount of time they gave in helping me better understand the relevance of John Dewey's writings to my project I wish to thank Dr. Paul Skilton-Sylvester and Dr. John Puckett. For facilitating my understanding of Lev Vygotsky's Zone of Proximal Development, I wish to thank Dr. Doug Frye. And for his thoughtful advice and encouragement when I was first learning to write ethnographic vignettes, I wish to thank Dr. Jeff Shultz.

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To the generous people I acknowledge here, and so many others too numerous to name individually, know that when I talk about my own "systems of support", I am talking about you!!!

Author's Note

On the recommendation of my English and History teachers, Mr. Krauss and Mr. Burns, I first read *Leaves of Grass* over the spring break of my senior year at La Salle Academy. Walt Whitman's vision of the American as both independent individual and interdependent citizen of the democracy had a profound impact on me. Much of what appears in this dissertation shows the continued influence that vision continues to hold for me. And so, during the course of this case study, it was my great pleasure to be able to share a passage from Whitman's opus with students of my own through formats which made sense to them — that is, the formats devised by the Universal Design for Learning team at The Bronx School for Occupational Studies.

The title of this dissertation is an allusion to one of the many rhetorical questions Whitman posed in "By Blue Ontario's Shore", namely "What is this you bring my America?" As a structuring device, I open each chapter with a quotation from this poem. The reader should be advised, however, that I often employ these quotations outside the contexts and connotations that Whitman likely intended.

The public school system where I conducted this study continues to classify many of my students as having "mental retardation" — a term I have never been comfortable using. Special Education literature today usually uses the term "intellectual and developmental disabilities", but I prefer "cognitive disabilities" and use that term throughout this dissertation.

ABSTRACT

WHAT THIS IS WE BRING YOUR AMERICA: THE CO-CONSTRUCTION OF AN ELECTRONIC PICTUREBOOK BY SPECIAL EDUCATORS AND THEIR STUDENTS ACCORDING TO THE PRINCIPLES OF UNIVERSAL DESIGN FOR LEARNING

John Francisco Fitzgerald

Dr. Jeanne Vissa, Chair

In 1997, one of the stipulations that Congress inserted into the reauthorization of the Individuals with Disabilities Education Act (IDEA-97) was the mandate that schools must give students with disabilities access to the very same standards-based curriculum as their non-disabled peers. Just as Universal Design emerged as a paradigm in architecture to meet the physical "access for all" mandates of the Americans with Disabilities Act earlier that decade, Universal Design for Learning (UDL) arose as a framework for providing students with disabilities entry points to the General Education curriculum.

However, since extant examples of curricula designed according to UDL principles are not comprehensive across all content areas, this study inquires into the process one group of educators, serving students with diverse mild through severe special needs, undertook in designing an electronic picture book based on a passage from Whitman's *Leaves of Grass* and linked to a specific standard in English / Language Arts. The study documents how the UDL team at this New York City school co-constructed

the electronic picture book with students and created challenging opportunities for these students so as to demonstrate the competencies their disabilities so often obscure.

Despite having neither explicit knowledge of Lev Vygotsky's concept of the Zone of Proximal Development nor of Paulo Freire's critical pedagogy, the educators in this study applied principles that correlate with those advocated by these two theorists. Findings in the study also illuminate new potential for electronic media in the education of students, with and without disabilities, even while revealing that tensions can exist in valuing and evaluating work completed independently and interdependently. The findings also show how the distinction between "teacher" and "student" can at times be blurred in Freirian fashion.

In its conclusion, the study argues against one UDL premise, namely that retrofitting curricula necessarily results in an inferior product. Since the medium of an electronic picture book can be expanded to address the needs of populations beyond those envisioned during the design of the initial versions, retrofitting may not be problematic to the degree that some proponents of UDL suggest.

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Who are you indeed who would talk or sing to America?

PREFACE

Who Are We Indeed?: Who We Are and Why We Chose Walt Whitman as the Subject of our Universally Designed Curriculum Units

Two years ago, on the teal-tiled wall outside the Bronx School for Occupational Studies' (B.S.O.S.) Programming Office, there hung a most puzzling poster by graphic artist Christoph Niemann. When viewed from a distance one saw the fuzzy white countenance of a bearded old man contrasted against a pitch black background. But when looked at up close, one could see that, astonishingly, on both the horizontal and vertical axes, this image was cleverly composed of text of varying font size that repeated the line: "National Poetry Month April 2007" (Academy of American Poets, 2007).

When I asked passing several staff members who they thought this poster portrayed, the responses ranged from Jerry Garcia to Karl Marx to Santa Claus to Rob Adams, an Auto Shop teacher who had retired from B.S.O.S. a few years back. But then Jaime B., a 21 year old student with Down syndrome and severely limited vocal capabilities, passed by on his way to drop off the day's attendance at the Programming Office. I stopped him long enough to ask him who he thought the poster portrayed. He responded with a tri-syllabic guttural utterance that might otherwise be meaningless to me but for the fact that he paired it with a double flash of the letter "W" in American Sign Language (ASL): W.W. — Walt Whitman.

I met up with Jaime B. in our classroom later in the day and from his work binder he dug out an old Mayer-Johnson Symbols picture-board that he used during our study of the poem / picturebook *Nothing But Miracles* (Whitman & Roth, 2003) the previous

December. He slipped this laminated picture-board into his Tech-Talk, but unfortunately this Alternative/Augmentative Communication (AAC) device was no longer programmed for the lesson on that poem. Still, when he pointed to the image on his board, I got the picture. Jaime B. was confirming for me what I had believed downstairs outside the Programming Office. Jaime B. knew full well the face on that poster belonged to Walt Whitman — or "W.W." as he called him in ASL.

So how was it that this student in a segregated special education school was so readily able to identify the portrait of Whitman when even some staff members were unable to do so? The answer lies in the fact that in addition to his studying of *Nothing But Miracles* earlier in the school year, during the previous two summer school sessions Jaime B. studied curriculum units on the life and poetry of Walt Whitman. These units were planned according to the principles of Universal Design for Learning by a core group of staff interested in UDL and were executed in collaboration with students in a select group of classes, like Jaime B.'s. Their co-construction of an electronic picturebook during the summer of 2006, entitled *from Poem of Joys*, is the focus of this case study.

There are several reasons why this core group of special educators on the UDL team chose Walt Whitman as the theme of the project. Foremost in their minds, this group needed a topic which would serve as an entry point into the general education curriculum for their special education students. They knew that whatever topic they chose, alignment with the standards of the general education curriculum was the litmus test that their project would ultimately have to pass. For in keeping with the letter of the law (i.e. IDEA-97 / PL105-17), they needed to provide their students with access to the same standards-based curriculum as their non-disabled peers — or at least one aspect of it. Going a step further, by creating the unit according to the principles of UDL, they offered not only "access to information", but also "access to learning" (Rose & Meyer, 2000).

The original idea for this project germinated with a leaflet that Ms. Carlixta brought to one of the UDL team meetings. This flyer announced the many events that were going to be taking place in the summer of 2005 to commemorate the 150th anniversary of the first publication of *Leaves of Grass*. The group felt that this anniversary would provide many opportunities for field trips, given that Whitman had lived so much of his life in Brooklyn and was so inspired by what he had seen in Manhattan.

Another benefit of the *Leaves of Grass* Sesquicentennial was the publication of three Whitman-related picturebooks that we incorporated into the unit. *Walt Whitman: Words for America* (2004) is a biography for children written by Barbara Kerley and illustrated by Brian Selznick. Its main foci are Whitman's service as a nurse during the Civil War and his reaction to the assassination of Abraham Lincoln. Loren Long's (2004) illustrated version of "When I Heard the Learn'd Astronomer" uses the text of Whitman's poem to tell the story of a boy in the mid-20th century (some 60-odd years after the poet's death) who is touched more by the wonder of the night sky's "perfect silence" than by all of the astronomer's "proofs", "figures", "charts" and "diagrams". In *Nothing But Miracles* mentioned earlier in this prologue, Susan L. Roth (2003) similarly takes a Whitman poem and, by pairing it with her collages, uses the text to tell what is likely a different story than Whitman had in mind. Hers is the story of a family of cats who travel together through town and country experiencing the "miracles" around them and celebrating the love between them.

Additionally, the UDL team decided to draw upon two older picturebook versions of Whitman's "I Hear America Singing". One was illustrated by Fernando Krahn (1975) and the other by Robert Sabuda (1991). Unlike the art work in the Long and Roth books, the pictures in both of these books basically illustrate the literal text of the original Whitman poem. Ms. Perez felt that particular attention ought to be paid to "I Hear America Singing" because of the links that could be made to the Bronx School for Occupational Studies' vocational mission. Quite a few of the careers mentioned in "I Hear America Singing" (e.g. mechanic, carpenter, mason, and seamstress/laundry worker) had counterpart career education labs at B.S.O.S. (e.g. Auto Shop, Carpentry Shop, Construction Shop, and Activities of Daily Living Shop).

Likewise this poem dovetailed with the "This Land is Your Land" and "America the Beautiful" thematic units that the students experienced as UDL pilot projects during the previous two summer school sessions. In the wake of the tragedies of 9/11/01, District 57's mandated "summer school themes" had a decidedly patriotic flavor. Ms. Perez was particularly interested in "making connections between (curricular) units" and in "demonstrating the continuity of learning" to the students.

The UDL team felt that a sustained study of Walt Whitman and his poetry would be justified by New York State's English Language Arts Standard 2, which reads:

> Students will read and listen to oral, written, and electronically produced texts and performances from American and world literature; relate texts and performances to their own lives; and develop an understanding of the diverse social, historical, and cultural dimensions the texts and performances represent. (University of the State of New York, 1996, p. 1)

Additionally, staff communicated with Ms. Rubi, a special education teacher at the Multilingual Academy of Professional Studies (MAPS) — the general education school housed on the top floor of B.S.O.S. Ms. Rubi confirmed that while Walt Whitman was not being studied just then, the poems in *Leaves of Grass* clearly fit into the ELA curriculum at the Secondary Level.

During the planning stages of the multimedia project *150 Years of Leaves of Grass* in 2005, UDL team chairman Mr. Reeds thought that the "diverse social, historical, and cultural dimensions" mentioned in the standard could be addressed by including Langston Hughes's poem "I, Too, Sing America" as a counterpoint to Whitman's "I Hear America Singing." Ms. Rodriguez and the students in her Bilingual Spanish class took on the responsibility of producing a UDL presentation on Hughes's poem.

In terms of multimedia format, most of the staff in the group had at least some familiarity with either the Hyperstudio or iMovie programs and I suggested that either would be perfect for developing the type of "electronically produced texts" mentioned in ELA Standard 2. And so our team was on its way towards creating a grassroots UDL project.

Another advantage of choosing Whitman's poetry to "universally design" a curriculum unit around was that *Leaves of Grass*, and many of the daguerreotype images of "the Good Grey Poet" as well, are in the public domain. On a practical level, this freed the members of the focus group to experiment with the possibilities of Universal Design for Learning as applied to Whitman's poetry without having to worry about infringing upon copyrights.

When it came time to embark on the study that would provide the actual data for this dissertation, the UDL team decided to expand the *150 Years of Leaves of Grass* pilot study project by adding to it an electronic picturebook version of a relatively obscure passage from *Leaves of Grass* called "Poem of Joys." This dissertation tells the story of the co-construction of that e-picturebook by the UDL team members and their students, as well as the response to it by some of those students.

In addition to the UDL team members mentioned above, who contributed to both this study and the pilot study, you will also meet UDL newcomers Mr. Barry, the Wood Shop teacher, and paraprofessionals Ms. Vernon and Ms. Julieta. Jaime B. was not formally part of this study, but in this dissertation you will meet his schoolmates Caridad C., Isaías M., Kevin I., Angela D., Milagros Q. and Bobby P. who each made meaningful contributions to various parts of *from Poem of Joys: an electronic picturebook* and then afterwards responded to the e-picturebook as a whole.

What is this you bring my America? ...

Is it not a mere tale? a rhyme? a prettiness?
— is the good old cause in it?

Chapter 1

INTRODUCTION

What Is This We Bring Our School?:

How a Tradition of Teacher-Student Collaboration Set the Stage for the Development of an E-Picturebook

After The Bronx Burned: A Phoenix Rises in a Special Education School

During one morning drive in July 2007, a full year after I collected the data for this case study, I was on my way back to work at the summer program at the special education school where I had collected that data. As I made my way down the Chief Nimham Expressway, a billboard caught my eye proclaiming "The Bronx Is Burning!" The finer print in this advertisement invited me to tune in to an ESPN mini-series, based on Jonathan Mahler's bestseller, and relive the madness that was The Bronx in the summer of 1977 — the "Son of Sam" killings, the blackout and accompanying riots, and the New York Yankees race for the American League pennant.

Continuing on my drive, billboard after billboard on both sides of the Nimham Expressway in 2007 continued this "Bronx Is Burning!" refrain, which was so misleading phrased as it was in the present tense. Soon the saturation campaign had its desired effect and I was drawn back to the October '77 of my childhood when Howard Cosell, in his signature drawn out cadence, recounted not only the World Series play by play, but also gave color commentary to the proverbial burning of the Bronx. Describing a fire at a public school a few blocks from Yankee Stadium, Cosell uttered the words that not only supplied the title for Mahler's book and the ESPN miniseries based upon it, but gave the country its enduring and indelible image of this much-maligned borough: "There it is, ladies and gentlemen, the Bronx is burning…"

I exited the Nimham Expressway while most of the other drivers continued on to their work destinations in other boroughs, or maybe outside the city. It saddened me because I feared that under the undue influence of those billboards they took with them to jobs in Manhattan, Queens, Brooklyn and points beyond, an image of the Bronx that was outdated and erroneous. Had but one of those other cars exited with me they would have found that today's South Bronx, at least during daylight hours, is one quite different than they would have encountered in 1977, 1987 or even 1997. For in 2007, the old burned out buildings were being razed and, in a massive construction boom, new ones were going up in their place.

Had I been able to entice at least one of those drivers to exit their 1977 reverie I would have led them past the Central Post Office on Grand Boulevard, home to Ben Shahn's "I Hear America Singing" mural — an homage that ties our Bronx to Whitman's "Mannahatta", his Brooklyn and ultimately, his America. We'd then head down East Bonilla Avenue and through the thriving Central Plaza, past all the early morning commerce and construction that would have no doubt delighted "the Good Grey Poet." With another turn or two we would have pulled up in front of The Bronx School of Occupational Studies (B.S.O.S.) — a sort of phoenix arising from the ashes of PS 3, the school that had burned down on national television three short miles away and thirty long years ago.

At that early hour we would have seen the students getting off the yellow school buses, many with visible disabilities, and most with smiles eager to get on with their day of learning. And as we passed Teddy, one of the school's maintenance crew, we would have had to shout our greetings to him and the arriving students over the noise of a pile-driver preparing a construction site up the street from the school. I would have invited this fellow commuter to come into our school and perhaps view *from Poem of Joys: an electronic picturebook*, the Universally Designed version of a Whitman excerpt, the construction of which is documented in this dissertation.

At the end of the visit, between Teddy's friendliness, the broad smiles on the students and the development and construction all around, of buildings and curriculum alike, this driver might have proceeded on to work in Manhattan, Queens, Brooklyn or beyond with a rehabilitated view of the Bronx. That is unless this driver happened to notice just what Teddy was sweeping up on the perimeter of the school grounds. The empty crack vials, used syringes and condom wrappers in his dustbin would have given ocular evidence that nighttime is still a different world in the South Bronx — a world to which each student at B.S.O.S. returns at the end of every school day.

I cannot go back to that summer morning in 2007 and invite that random driver on the Chief Nimham Expressway to come visit my school. But what I can do is invite you, the reader, to journey back to B.S.O.S. one summer before (i.e. 2006) and watch as a team of my special education colleagues and our students mirrored the building boom outside the classroom windows and co-constructed *from Poem of Joys: an electronic picturebook*. This case study documents the development and utilization of an e-picturebook based on a poetry excerpt, so in broad terms there is "rhyme" and "prettiness" in it. And as in all good case studies, I do not wish it to be a "mere tale." It is therefore my hope and goal that in some way, however small, this case study will expand upon the promise that electronic media and a concept called Universal Design for Learning hold for *all* students, both with and without disabilities.

"The Good Old Cause": Alive and Well at B.S.O.S.

In this dissertation I will describe and analyze how several teachers at B.S.O.S. committed themselves to a "cause" and, through collaborating with their students, built a curriculum unit. And just as those new edifices in the surrounding neighborhood were planned according to the architectural principles of Universal Design, as required by the Americans with Disabilities Act, my colleagues planned their curriculum unit according to the principles of Universal Design for Learning (UDL), in the truest spirit of the Individuals with Disabilities Education Act (IDEA).

Likewise, this team was also enacting their plan in accordance with New York State's Chapter 377 regulations that called for the development of a plan that would "ensure that all instructional materials to be used in the schools...are available in a usable alternative format for each student with a disability" (Vocational and Educational Services for Individuals with Disabilities, 2001). At the heart of this regulation is the sense that the very same content that is made available to students without disabilities must be made available to their peers with disabilities.

At the time of this study, B.S.O.S. was a de facto segregated special education center with student enrollment of approximately 500 students. But as UDL practices are appropriate in every type of educational setting, the relative pros and cons of separate and inclusionary education are not addressed in this dissertation. B.S.O.S., primarily serving adolescent African-Americans and Latinos with disabilities, was divided into three high school programs, termed Specialized Instructional Environments (SIE): one for students with learning disabilities (SIE IV), another for students with severe cognitive disabilities (SIE V), and the last for students with emotional disabilities (SIE VII). Students in the former two programs took the New York State Alternate Assessments (NYSAA), as opposed to standardized state-wide tests, and were the subjects of this case study. Multilingual Academy of Professional Studies (MAPS), a small foreign language "magnet" school, was housed on the top floor of the building, but offered only a select few B.S.O.S. students opportunities for "academic inclusion."

In the popular imagination of our nation the Bronx is still aflame. And there is some truth to that, if only metaphorically. Crime rates in the neighborhoods that comprise the South Bronx are still disproportionately high, the area remains at the epicenter of both AIDS and asthma crises and the local congressional district continues to be the poorest in the United States (Kozol, 1995). If hollowed-out tenement shells are the enduring, yet fallacious, icons of the South Bronx, then the parallel images held of the disabled youth who happen reside in its neighborhoods are of damaged children with attendant stigmas of despair and helplessness.

But each morning 200 teachers, paraprofessionals, related service providers and ancillary staff disregard the stereotypes, confront the realities and show up at B.S.O.S.'s front doors. In the words of the former principal, Mr. Rourke: "They have not given up on the kids the way that society seems to (have). They come to the table with something to offer…they come with expectations that are both high and realistic" (personal

MULTIPLE PATHWAYS TO LEARNING: AN EXAMINATION OF UNIVERSAL DESIGN AND ONLINE STRATEGIC LEARNING IN HIGHER EDUCATION

by

Maryruth Wilks Hicks

KIMBERLY RYNEARSON, Ph.D., Faculty Mentor and Chair

CAROL HOLZBERG, Ph.D., Committee Member

ED MAYBERRY, Ed.D., Committee Member

Barbara Butts Williams, Ph.D., Dean, School of Education

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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Abstract

The purpose of this study was to examine the effectiveness of universally designed (UD) instruction on strategic learning in an online, interactive learning environment (ILE). The research focused on the premise that the customizable, media-based framework of UD instruction might influence diverse online learning strategies. This study investigated UD model concepts for cognitive, constructivist, and media-based principles which incorporate multiple pathways to learning and intelligent technologies. The Learning and Study Strategies Inventory for Learning Online (LLO), an 11-scale, 88-item instrument was used to assess information processing, self-testing, and study skills which contribute to self-regulation and meaningful learning. Additionally, the LLO was used to assess collaboration skills which emphasize online communications strategies. This study did not assess the LLO components for anxiety, attitude, concentration, motivation, selecting main ideas, time management, and test strategies. Seventy-seven undergraduate students majoring in business and social sciences participated in the quasi-experimental, non-equivalent control group design. LLO pre-instructional and post-instructional scores were collected and analyzed to determine if UD media-based principles for flexibility and customization influenced meaningful learning and collaboration skills among adults with diverse strategic learning abilities. During a ten week term, participants in both groups learned statistics in the Blackboard course management system (CMS); in addition to using Blackboard, the experimental group accessed assignments using CengageNOW, a CMS that features UD tools for customizable learning, a personalized study plan, and intelligent tutors. Statistical results indicated that there were no significant differences in strategic learning abilities between groups using UD and those not using UD. Results of

the study suggested that men and women differ significantly in online information processing abilities, self-testing, and study skills. Participants were less skilled in online collaboration than in any other concept under investigation. Even though this study did not assess motivation, which is considered a critical aspect of learning acquisition, current research indicates that motivation positively influences study strategies and academic performance. Future research about UD instruction and adult online learning should examine motivation, collaboration, and the role that customization plays on all online strategic learning components.

Dedication

I dedicate the commitment, perseverance, and determination to complete this project to the memory of my parents, the late William Wilks, an unwavering provider and jack-of-all-trades, and to the late Ruth Briggs Wilks, an apprentice who later become a mentor, coach, role-model, and expert to hundreds in her field. My parents were visionaries that made lifelong sacrifices so that I could pursue and reach extraordinary academic heights—they paved the way and dared me to dream. Today, their hopes and my dreams have been fulfilled through the completion of this advanced degree!

Additionally, I dedicate my dissertation topic to the memory of the late Virginia (Ma Ginny) LaBrot, a retired teacher, mentor, and Air Force educator, who at the age of 85, demonstrated expertise in the fields of andragogy and inclusive pedagogy. Virginia LaBrot's skill and passion for responding to special needs and learning diversity in higher education enabled thousands of Air Force men and women to achieve academic and vocational success to the fullest extent. Even though she initially resisted the Air Force's migration to the use of technology in the classroom, Virginia LaBrot spent many of her final days teaching and collaborating with adults in online settings. Today, her passion for responding to learning diversity in higher education lives through this project!

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I owe my deepest gratitude and respect to my mentor and dissertation chairperson, Dr. Kimberly Rynearson, for her expertise, thoroughness, statistical prowess, timely feedback, and superb direction. I am especially appreciative to committee members, Dr. Carol Holzberg and Dr. Ed Mayberry, for their wisdom, continued guidance, patience, and indelible dissertation support. A very special "thank you" goes to Capella University's School of Education, its academic support staff, and to Dr. Nan Thornton, the IDOL faculty chairperson, for her expertise and futuristic leadership. Additionally, I extend my sincere appreciation to supportive faculty sponsors and to Dr. Deb Gearhart, Director of Distance Learning, at the data collection site.

Lastly and reverently, I thank God for this moment, opportunity, and accomplishment.

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CHAPTER 1. INTRODUCTION

Introduction to the Problem

Instructional design is at its best when the model complements individual learning differences at the onset of instruction (Rose, Meyer, & Hitchcock, 2006). Two primary goals for instruction include the desire to increase individual knowledge about specific topics and to improve task-related skills, abilities, performance, and knowledge transfer. Designers commonly use theories about teaching, training, and learning along with objectives-based models to create knowledge and performance enhancing instruction. Instruction for training and vocational learning might emphasize skill building while instruction for academic settings tends to focus on fostering knowledge construction and transfer (Reigeluth, 1999). According to Reigeluth, situations and methods are key design factors that determine which instructional strategies are more likely to result in the desired outcomes based on learner characteristics and learning theory. When theory-based instructional strategies result in improved learner performance within a specific learning situation, educators and designers conclude that the instructional model is *effective* (Richey & Klein, 2007). This investigation focused on instructional model effectiveness among diverse online adults situated in higher education.

Instructional situations consider learning conditions—what to teach, what learners already know, how individuals learn, where instruction will occur, instructional goals, and instructional planning (Brown & Green, 2006). This study involved emerging trends that prompt the need to focus on alternative and effective, theory-based instructional solutions for adult online learning. One trend involves the renewed interest among educators and educational psychologists about supporting intrinsic and unobservable concepts involving learning strategies, which deals with how individuals learn and integrate knowledge. Numerous findings within the research literature on training and learning reveal the importance that learning strategies play in knowledge construction (Deci, 2006; Moreno, 2006; Weinstein, Palmer, & Schulte, 2006). A second trend involves the accelerated growth rate of adults in post-secondary online settings. During the next 20 to 30 years, experts predict that increased numbers of adult learners will enter online situations with a wide range of diverse learning needs. Globalization, which results from the merger and integration of international and social economies throughout the world, contributes to the wide range of diverse learning needs, as well as to the complexity of creating effective instruction in online situations (Fisher, 2000).

Another instructional design concern heightened by growth trends among adults in online settings involves support for learners as they transition from passive to active learning environments (Silberman, 2006). This transition from passive to active situations involves adjusting from teacher-centered to student-centered instructional activities. According to Brown (1997, pp. 399-413), as learners make the change from passive, face-to-face situations to active, online environments, learners with faulty learning strategies might experience instructional gaps. Because online learning environments give learners more control over tasks involving knowledge construction and integration, instructional supports will need to be in place soon after instruction begins to help learners adjust to self-directed learning (Jonassen & Land, 2000; Land & Hannafin, 2000). According to Gardner, Jeweler, and Barefoot (2008), degree of autonomy and level of responsibility are the two most cited differences between high school students and those attending college. Even though educators expect adults to use appropriate learning strategies by the time they enter college, many adults have not developed the independent learning strategies needed for successful learning (Weinstein et al, 2006). Essentially, in addition to incorporating flexible instruction to make knowledge more accessible to a wider range of learners, some adults headed to online environments will need guidance in *how to learn* in active situations.

Weinstein et al. (2006) indicate that strategic learning abilities assist learners with how to learn activities involving time management, study skills, test preparation, selecting main ideas, and regulating the learning process. Additionally, Weinstein et al. indicate that study skills, self-testing, information processing, and collaboration contribute to meaningful learning, each of which is important to successful online learning. The claims by Gardner et al., and Weinstein were relevant to this study because autonomy, responsibility, self-assessment, metacognition, meaningful learning, and collaboration are critical aspects of strategic learning. This study discussed the importance of choosing appropriate instructional models to create effective online instruction that supports flexibility, metacognition, meaningful learning, collaboration, and ultimately strategic learning.

Objectives-based models focus on standardization while learner centered models focus on meeting diverse learning needs through flexible, customizable instructional solutions. Even though objectives-based models are theoretically sound in many different learning situations, their one-size-fits-all instructional approach does not emphasize learning diversity; essentially one-size-fits-all instructional models might be too rigid and less effective among adults with a wide range of learning differences (Thousand, Villa, & Nevin, 2007). In online settings, when instruction is not designed to accommodate diverse learning needs, learning differences might negatively shape outcomes.

Learner-centered models extend the benefits of the Instructional Systems Design (ISD) approach by integrating customizable solutions that incorporate media-based techniques, which can be implemented to enhance instruction. In addition to information from Clark (2003) and Mayer (1999b), Moreno and Sorden (2005) emphasize the importance of using media-based instruction to foster retrieval and recall. This study was based on an urgent need to investigate flexible, learner-centered instructional models that integrate multimedia to foster effective strategic learning instruction as an alternative to rigid, less flexible objectives-based models.

The use of instructional multimedia incorporates theories about learning with verbal and visual cues, optimizing working memory and cognitive load, and capacity as it relates to information processing. Information processing is a critical aspect of meaningful learning that involves skilled metacognition and successful knowledge transfer (Ausubel & Fitzgerald, 1961, pp. 266-274). Meaningful learning involves active learning processes in which the learner adopts a system for linking and relating new information with previously learned knowledge. As individuals construct knowledge, metacognitive skills enable individuals to select important information, decide what they know, seek help, assess task completion, distinguish effective processes, and evaluate success. Designing for meaningful learning might be complex because individuals construct and integrate knowledge based on personalized encoding systems and different strategic learning abilities. While experts disagree about the benefits of using multiple forms of instructional media, Clark (2003) provides an expert opinion about the effectiveness of multimedia methods to enhance knowledge construction and meaningful learning.

Clark emphasizes the notion that instructional methods that incorporate media foster learning, but the use of media alone does not. Moreno and Valdez (2005) point out that dual media forms reduce cognitive load, enhance elaboration, and help learners as they develop mental models. Reports from Ghefaili (2003) along with information gained from Rose and Meyer (2002, 2006) indicate that media based instructional methods set the stage for designing flexible, online learning situations that focus on multiple ways to construct knowledge and multiple ways to participate in collaborative, interactive meaningful learning with expert guidance.

In order to plan for diverse learning needs at post-secondary levels, several universities are examining the emergent universal design model as an alternative to one-size-fits-all, objectives-based instruction. Universally designed instructional models emphasize knowledge construction and front-end customization through media-based principles, which broaden the capacity to create flexibility and multiple pathways to learning for a wide range of individuals (Rose & Meyer, 2002, 2006). The theoretical framework of universal design models is that by planning and designing flexible, media-based instruction to accommodate specific learning needs at the onset of instruction, all learners benefit. Unlike traditional one-size-fits-all systems models, universal design models prescribe inclusive instruction that anticipates individual differences and plans customized strategies that complement rather than separate instruction for special needs learners (Rose & Meyer, 2002, 2006).

A number of studies about universally designed instruction report success among elementary and secondary learners, but research about universal design model effectiveness for strategic learning in higher education is still evolving (Council on Exceptional Children, 2003; Higbee, 2003; Hatfield, 2003). Recent studies about the implementation of universal design in post-secondary settings show promise; however, much of the current model research about universally designed instruction in higher education centers on special needs, accessibility, and achievement. Many institutions classify students with strategic learning deficiencies as struggling learners rather than as special needs learners. Consequently, there is a limited amount of current research about a possible connection between universal design, improved strategic learning, and academic success at post-secondary levels. For that reason, there is still a lot to learn about the possible benefits of incorporating universal design model principles to support online strategic learning in higher education. Insufficient information about universal design model effectiveness among post-secondary adults with diverse strategic learning needs creates a problematic knowledge gap for online learning designers (Muis, Winnie, & Jamieson-Noel, 2007, pp. 177-195).

Strategic learning is an essential aspect of online learning success and it was therefore important to investigate the effectiveness of the universal design model in post-secondary online situations where growth among diverse adult learners expects to reach record-breaking numbers through the year 2040 (U. S. Department of Education, 2000, pp. 2-10). One way to learn more about how universal design influences adult strategic learning was to investigate the model in the context of the learning situation; essentially, how key knowledge might be gained by assessing strategic learning abilities prior to and after an instructional invention that incorporated universal design model principles.

The remainder of this chapter provides background information about the flexible, media-based, customizable universal design model and how universal design models might influence intrinsic concepts involving adults with different strategic learning abilities in active, online learning situations.

Background of the Study

This section discusses the numerous instructional design considerations involved in planning effective online instruction that targets adult strategic learning needs in higher education. Topics include media-based instruction and theories, emergent trends in instructional design for online learning, universal design model principles, learning diversity, and assessing online strategic learning.

Situational Leaning Needs

Designers might take at least two approaches to plan instruction that targets specific situational outcomes and diverse learning needs: they might continue to create objectives-based strategies from the traditional, systems models or they might devise customized strategies from non-traditional, learner-centered models. Experts believe that systems models and customizable models contribute different theoretical advantages to instructional design and situational learning (Brown & Green, 2006; Morrison et al., 2001; Rose & Meyer, 2002, 2006). Within the realm of using learning theories to plan goal-oriented instruction, designers frequently consider differences in learner characteristics such as gender, age, language, culture, experience, education level, and learning styles; individual differences are important because some experts believe that personal characteristics influence learning outcomes (Alessi & Trollip, 2001; Brown & Green, 2006; Reigeluth, 1999).

During recent years, there has been increased emphasis placed on learning styles research; learning styles include the strategic learning preferences that individuals use to generate knowledge. Many learner characteristics, including those that relate to learning styles, might be more apparent than internal processes such as strategic learning. Experts have determined that unobservable and less apparent learning differences in information processing and strategic learning techniques play an equally important role in determining success (Brown & Campione, 1986, pp. 1059-1068; Weinstein et al., 2006). According to Brown and Green (2006), in addition to information processing, memory, motivation, and concentration, concepts about planning, monitoring, and metacognition complement cognitive learning abilities. Metacognition deals with learning awareness, reflecting, thinking about thinking, learning control, and strategic learning (Alessi & Trollip, 2001; Brown & Green, 2006; Weinstein et al., 1998, p. 17). Current research reveals that because online enrollments are reaching new growth levels, there is a need to gain more knowledge about instructional strategies that support strategic learning in online settings (Aleven et al., 2003, pp. 277-320; Irlbeck, Kays, Jones, & Sims, 2006, pp. 171-185; Moallem, 2007, pp. 217-245; Whipp & Chiarelli, 2004, p. 5). What do instructional designers need to know about strategic learning?

Strategic Learning Needs

There are just as many strategies for learning as there are individuals in learning situations. Instructional support for strategic learning is important because strategic learning skills comprise concepts about metacognition, meaningful learning, self-regulation, and collaboration (Ausubel & Fitzgerald, 1961, pp. 266-274; Weinstein et al., 2006). Experts use the terms self-direction, self-regulation, self-correction, metacognition, and strategic learning to explain motivation and the skills needed by individuals to plan, monitor, regulate, and control their learning activities (Knowles, 1975; Brown, 1997, p 399-413; Simpson & Nist, 2000, p. 528; Ruban, McCoach, McGuire & Reis, 2003, p. 270). Additionally, metacognition, self-regulation, and collaboration are important for meaningful learning, which involves knowledge transfer and integration (Ofiesh et al., 2004, pp. 57-70; Pisha et al., 2001, pp. 197-203). Because knowledge transfer and integration are important for successful learning, it is important to consider individual strategic learning differences during the instructional design process. Four key strategic learning aspects pertinent to this study about designing effective and flexible online instruction for higher education involve strategic learning concepts for self-testing, study skills, information processing, and collaboration.

Instructional Design and Learning Differences

Current research reveals that designers disagree on the importance of individual learning differences and therefore many designers use traditional approaches that do not emphasize strategic learning needs (Brown & Green, 2006; Burgstahler, 2005, universal design of Instruction section, ¶1; Rose & Meyer, 2002, 2006). For a number of years, designers have integrated various theories with systems design models to plan effective, objectives-based teaching and training. Models based on the instructional systems design framework provide the structure for analyzing instructional needs, planning instruction for a specific population, and incorporating ad-hoc modifications when unique learning needs emerge after instruction begins. Instructional designers commonly use a five-phase systems model that organizes and guides the design process: analyze, design, develop, implement, and evaluate.

In addition to the 5-phase systems approach that describes and explains successful instructional design processes, the systems design process is also recognized among designers as the ADDIE (Analyze, Design, Develop, Implement, and Evaluate) model that prescribes, promotes, and regulates effective instructional design (Brown & Green, 2006; Hodell, 2005). Because systems models focus on learning deficiencies, mastery learning, and immediate behavioral change evidenced by instructional outcomes, planned systems-based strategies tend to underestimate the importance of intrinsic aspects involving individual differences in culture, language, cognitive ability, personal experiences, and metacognition (Alessi & Trollip, 2001; Aleven et al., 2006, pp. 101-130). Therefore, when unique learning needs become apparent, systems models call for retrofitted interventions. According to proponents of front-end universal design models, retrofitting might involve unplanned instructional costs and delayed solutions (Abell, 2006; Burgstahler, 2005; Scott, McGuire, & Shaw, 2003). Additionally, retrofitted solutions might not be as practical for online settings where learners expect access to guided instruction 24 hours per day, seven days per week (Belanich et al., 2005, p. 2).

What do instructional designers need to know about adult online learners?

Growth and Diversity in Online Learning

Adults enter learning situations with different experiences, different reasons for selecting online environments, and varied approaches to learning. In 1999, the Web-based Education Commission report to the Department of Education estimated that there were 77 million adults enrolled at post-secondary institutions with a mere 12 million meeting the profile of 18 to 24 year old traditional students who attend full time and live on campus. Enrollments among adult online learners and among students classified as non-traditional learners have climbed to a record 15 million since the fall of 2000 with less than 20 percent participating in face-to-face learning (U. S. Department of Education, 2000, p. 4). Reports by Allen and Seaman (2007) and from the U. S. Department of Education expect the 15 million post-secondary adult enrollments to increase 22 percent by 2010, primarily with part-time, online students who are at least four to five years older than new high school graduates who are entering college for the first time. Additionally, the Web-based Education Commission report to the U. S. Department of Education predicts that adults participating in online courses through work-based, corporate universities will exceed the number of students enrolled in face-to-face settings by the year 2010. Experts expect enrollments among adult online learners to increase at remarkable rates through the year 2040 (Vovides, Sanchez-Alonso, Mitropoulou & Nickmans, 2007, p. 65; U. S. Department of Education, 2000, pp. 2-10). Growth trends among non-traditional online learners and globalization fuel the urgency of taking a proactive rather than reactive approach to meeting diverse online instructional needs. Globalization adds complexity to the design of instruction to meet diverse needs.

Globalization. The U. S. Department of Education (2000, p. 5) expects more than 160 million international students to participate in higher education learning within the United States by 2025. According to Johnson and Fox (2003), globalization contributes to the complexity of using effective design strategies to accommodate a wide range of learners with different cultural and language backgrounds. Meeting the learning needs of a larger population of students with diverse cultural experiences and language needs will be just as challenging as providing effective instruction to meet the needs of online learners with different abilities and approaches to learning.

Twenty-first century instructional designers face multifaceted challenges as they prepare to meet a vast range of unique learning needs in online settings (Irlbeck et al., 2006, pp. 171-185; Lightfoot & Gibson, 2005, pp. 269-277; Merrill, 2007, pp. 5-22). Expected growth among online learners with diverse needs precipitated this evaluation of alternative instructional design solutions that focus on individual differences and strategic learning. Systems-based models, while effective in many training and learning situations, focus on objectives rather than on individual differences. The wide range of strategic learning differences among increasing numbers of non-traditional online learners is one concern that prompted this model effectiveness investigation about universal design. It is quite possible that educators will not be prepared because less flexible, traditional design models cannot meet the challenge of providing effective instruction to support diverse strategic learning needs among millions of online adults.

A Case Study of Universal Design for Learning Applied in the College Classroom

Marie E. Leichliter

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Neal Shambaugh, Ph.D., Chair
Cindy Beacham, Ph.D.
Ugur Kale, Ph.D.
Jaci Webb-Dempsey, Ph.D
Pamela Whitehouse, Ph.D.

Department of Technology, Learning, and Culture

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ABSTRACT

A Case Study of Universal Design for Learning Applied in the College Classroom

Marie E. Leichliter

As the landscape of education and the demographics of the postsecondary classroom continue to evolve, so too must the teaching practices at our nation's institutions of higher education. This study follows an instructor who has evolved to incorporate Universal Design for Learning (UDL) techniques into her classroom, even though prior to participation in this research study, she had not heard of UDL. UDL is a flexible framework used to design curricula that enable all learners to acquire knowledge, skills, and motivation to learn. This qualitative, descriptive case study addressed how and to what extent UDL techniques are being implemented in the college classroom and what student's perceptions of how these UDL techniques affect their learning. Data were collected over the course of a semester via field-based observations, semi-structured interviews, a survey, and a review of course materials. The case study participants included 38 students and an assistant professor at an institution of higher education in West Virginia. Results indicated that the instructor was implementing many UDL techniques in her classroom and that the majority of students both acknowledged and positively received these techniques. The data gathered during this study also revealed that the implementation of UDL in the college classroom is more than mere theory; the application of the UDL framework and principles are practical. Neuroscience suggests that no two students learn the same way or experience the same event with identical observations; responses are as unique as our fingerprints or DNA. As educators, our instruction must meet the needs of unique and diverse learners. UDL assists instructors to meet a diversity of needs through a single curriculum design. Research studies indicate that UDL is "best practice" teaching.

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Finally, I would like to thank the Lord above for the all these remarkable people. I believe each person we meet in our lifetime alters us in some manner. I am a better person having known all of the people on this page.

This study is dedicated to all the future researchers who will continue delve into the vast expanse of knowledge that Universal Design for Learning can provide the world of education. I know we are only at the beginning.

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Chapter 1

An Introduction to Universal Design for Learning (UDL)

A Case Study of UDL Applied in the College Classroom

As the landscape of postsecondary education continues to transform, educators are in a constant search for new approaches that will reach an ever-changing population of students. One contemporary model being applied in the college classroom is Universal Design for Learning (UDL). UDL is an instructional design model, or design template, that provides a framework for flexible teaching techniques that present students with choices and alternatives in materials, tools, contexts, and supports they can utilize to gain greater understanding of instruction and to be more successful learners. As UDL is a modern method of instruction, further investigation is warranted to examine the use of UDL in higher education.

The proposed case study explored the following: (a) how and to what extent UDL techniques are being implemented in the college classroom, and (b) what are the student perceptions of how UDL techniques affect their learning. The study investigated the various UDL techniques being implemented in a college classroom where the primary pedagogy is a constructivist approach, identified student perspectives of this use, and discussed possible outcomes of using the UDL techniques.

Instructors of higher education are being expected to meet the widely divergent needs of an increasingly diverse student body. As we move toward the ideal of inclusion and success for all learners, UDL may be an evident solution. As a contemporary instructional design method, UDL's application in and impact on higher education should be investigated.

Significant Shifts in Student Demographics

Societal changes in culture and technology have lead to amendments in legislation and developments in education that have profoundly altered the student composition of the traditional classroom. Many of today's college classes include: students with a multitude of cultural backgrounds, students from under-represented groups, international students for whom English is a second language, students who may not have proficient literacy skills, non-traditional students of varying ages and experiences, students with behavioral, emotional, motivational, physical and learning disabilities, students with chronic illnesses, academically-gifted students, and those students often referred to as typical (Rose & Meyer, 2002).

Institutions of higher education have experienced a rapid transformation of their student populations. Growth in technology and the birth of an information age have resulted in economic and social changes that have drastically affected enrollment numbers at colleges and universities throughout the United States (Scott, McGuire, & Shaw, 2003). High school students have come to realize that a college degree is virtually a requirement to obtain even an entry-level position in any professional field. In 2004, 94 percent of the students surveyed in an educational research study conducted by the United States Department of Education Office of Educational Technology stated that they planned to continue their education after high school and 88 percent of those students stated the belief that attending college is critical to success in life (U.S. Department of Education, 2004). Many adults who have been employed for years in an occupation are becoming aware that a postsecondary education is necessary for advancement, or they are deciding to return to school for a complete change in career. In the year 2000, over "15 million students enrolled in postsecondary education" (Scott, McGuire, & Shaw, 2003, p. 369).

Enrollment numbers continue to increase and traditionally underrepresented groups are quickly shifting student demographics at American colleges and universities.

According to a 2000 study conducted by the Educational Testing Service of the National Center on Education Statistics, researchers predict that enrollment at American institutions of higher education will continue to increase over the next 15 years by 19 percent and minority students will represent 80 percent of the total growth (Lords, 2000, as cited in Scott, McGuire, & Shaw, 2003). As the population of the United States continues to grow more diverse, classrooms too will become increasingly diversified in heritage, culture, and spoken language. The research gathered in 2004 by the United States Department of Education Office of Educational Technology indicated that of the 50 million students enrolled in the K-12 education system, 30 percent of the population was comprised of minority students – "representing the largest and most diverse student body in our history" (p. 16). This diverse population of students has already begun to progress into postsecondary education, and these numbers are expected to continue to increase.

In addition to minority students, adult students of nontraditional age have been increasing in number over the last couple of decades (Scott, McGuire, & Shaw, 2003). According to the United States Department of Education National Center for Education Statistics, a nontraditional student is defined as an individual who meets any or all of the following characteristics: a student who (a) has delayed their enrollment in postsecondary education, (b) attends only part-time, (c) works full-time while enrolled in study, (d) is financially independent when determining financial aid eligibility, (e) has dependents that are not a spouse, (f) is a single parent, (g) or does not possess a high school diploma (2007). A study done in 1998 revealed that almost 40 percent of the student population surveyed were 25 years of age or older (Scott, McGuire, & Shaw, 2003). Recent research studies indicate that the proportion of students over the age of 25 "may exceed 50% by 2012" (O'Donnell & Tobbell, 2007, p. 313). The adult student population brings a diverse set of experiences, backgrounds, knowledge, and special needs related to being a nontraditional learner for which educators must be prepared.

Educators at postsecondary institutions should also be ready for a dramatic increase in students with special needs related to disability. In addition to social and economic trends, government legislation and subsequent changes in the special education systems of K-12 schools have drastically affected the number of students with disabilities who graduate from high school and decide to pursue a college degree. According to a research survey conducted during the fall 2000 semester, 66,197 full-time freshman attending public and independent colleges and universities reported having a disability. This number represented 6 percent of all freshman enrolled during the fall 2000 semester (Henderson, 2001). During the 2003-2004 college year, a similar study conducted by the United States Department of Education National Center for Education Statistics revealed that 11 percent of the undergraduate population reported a disability (2006). The number of students with disabilities in the college classroom rose 5 percent in only a four-year period. According to the National Dissemination Center for Children with Disabilities, more than 6 million children with disabilities are currently in the K-12 public school system (2007). If public education transition services for students with disabilities continue to improve, as they have over the last five years, postsecondary institutions can anticipate sustained growth in the numbers of students with disabilities.

NCLB, IDEA, and 21st Century Skills

Transition services, planned activities and training sessions that help a student progress from high school to a vocation or postsecondary education, have improved as a direct result of government legislation. Amendments to the Individuals with Disabilities Education Act (IDEA) in 1997 placed great emphasis on the transition of students with disabilities into the higher education system (Scott, McGuire, & Shaw, 2003).

While many of the mandates in the IDEA are relatively recent, the legislation itself is not new to the education system. In an effort to protect the civil rights of children with disabilities in the K-12 public school system, the Education for All Handicapped Children Act was passed in 1975. This legislation was renamed the Individuals with Disabilities Education Act (IDEA) in 1990 to reflect significant expansion and revision. Since this time, the IDEA has been reauthorized in 1997 and again in 2004. The current IDEA requires that schools educate students with disabilities in classrooms among their peers without disabilities to the greatest extent possible (2004).

In addition to IDEA regulations, educators must also comply with No Child Left Behind Act (NCLB) mandates. The NCLB Act of 2001 requires inclusive classrooms where all students are to receive equal access to education and are to demonstrate adequate yearly progress based upon state academic achievement standards. Due to NCLB legislation, schools are held accountable for how diverse demographic groups, including minority students and those with disabilities, achieve in comparison to their peers enrolled at the same school (NCLB, 2002). NCLB legislation has established 2014 as the deadline when "achievement gaps between different socio-economic backgrounds must be identified – and closed – so that all children regardless of race and income level can read and do mathematics at grade levels" (U.S. Department of Education, 2004, p. 13). The basic premise of NCLB is "that all children can learn" (U.S. Department of Education, 2004, p. 13).

The practice of inclusion, or the mainstreaming of children with special needs into classrooms of their peers, and the significance placed on accountability measures have generated much angst among education professionals. Implementing these government accountability mandates is a challenge for both administrators and educators who do not consider themselves trained in how to meet the needs of diverse student learners and who are unwilling to learn new methods of instruction.

New education mandates like NCLB and the IDEA necessitate that K-12 public school educators and administrators discover methods to meet new standards-based goals and objectives if they are to continue receiving government funding. In an effort to encourage school officials' endeavors to implement new programs and meet these mandates, the federal government established discretionary and formula grant awards through the Department of Education. Schools throughout the United States are receiving government monies to increase and update their educational technology, provide professional development for administrators and educators, and to implement new instructional design methods that will allow all children to learn in an inclusive classroom environment (U.S. Department of Education, 2007).

In alignment with NCLB standards and accountability measures, an advocacy group known as The Partnership for 21st Century Skills has generated a list of core skills that today's students need for success in their careers, to act as informed citizens, and to serve as leaders in their communities. The Partnership for 21st Century Skills is an advocacy group comprised of individuals representing both education and industry who believe that a profound gap exists between the knowledge and skills learned in the classroom and the knowledge and skills needed in the community and for employment. Proponents for 21st Century Skills argue that curricula should focus on the following: (a) core subject areas as identified by No Child Left Behind

(NCLB), (b) learning and innovation skills, (c) information, media and technology skills, and (d) life and career skills (Partnership for 21st Century Skills, 2004). The philosophy of 21st Century Skills is gaining momentum in the field of education and nine states, including West Virginia, currently have statewide initiatives to implement these changes in their curricula. The principles used to integrate 21st Century Skills into the classroom are reflective of NCLB and also resemble those used for Universal Design for Learning (UDL).

Legislative Prescription for Universal Design for Learning

When one familiar with Universal Design for Learning (UDL) reads the language in the No Child Left Behind (NCLB) Act, the governmental mandate seems a prescription for the implementation of UDL. NCLB describes a new, more flexible instructional design model that embraces the use of instructional technology to provide multimodal education experiences and opportunities for students (U.S. Department of Education, 2004).

The four main purposes of the NCLB act are: (1) to hold schools accountable for the education of all students, (2) to increase flexibility in education to help schools reach established goals, (3) to provide options for parents if their children are enrolled in low-performing schools, and (4) to encourage research on what is most effective for student learning (U.S. Department of Education, 2004). According to the U.S. Department of Education, “this single piece of legislation has fundamentally altered the education landscape. Its premise – that all children can learn – is profound in its simplicity but multifaceted in its implementation” (2004, p. 13).

The premise that all children can learn, the first and foremost purpose for NCLB, is the keystone around which the instructional design model known as Universal Design for Learning (UDL) has been built. UDL is an instructional design model used to generate curricula that are accessible by all students, or the largest audience possible, to ensure student success and participation (Rose & Meyer, 2002).

As proposed in NCLB, UDL is fashioned around the philosophy that education must be flexible if a wide audience is to be reached. UDL designed curricula offer multiple ways for learners to acquire and access knowledge, multiple means for demonstrating what they have learned, and multiple methods to increase learner interest, motivation, and challenge level (Center for Applied Special Technology, 1999).

The UDL model of instruction seeks to generate curricula and materials that are better suited to reach a multitude of diverse learners and learning styles. By addressing the issue of diversity at the level of curricula development, educators can more effectively reach a greater number of students while monitoring built in assessment measurements to meet the standards mandated by NCLB and IDEA. Scholars studying the UDL approach to education indicate that it can provide a more flexible method for instruction that will lead to more effective learning and therefore a reduction in low-performing schools or classes (Center for Applied Special Technology, 1999).

Also in compliance with the purposes of NCLB legislation, individuals from an organization known as the Center for Applied Special Technology (CAST) are working with K-12 schools, colleges and universities, and other partners in education to assist these institutions in their implementation and evaluation of UDL. Members of CAST's staff conduct professional development and research activities to gather information about what methods and strategies are most effective for student learning. These staff members are working with select schools and postsecondary institutions throughout the United States to help establish UDL as the method to reach students who are traditionally left in the margins (Rose & Meyer, 2002).

Universal Design for Learning: A New Paradigm in Education

Universal Design for Learning (UDL) was first conceived by the Center for Applied Special Technology (CAST) in the early 1990's as an application of the universal design movement in architecture to the field of education (Center for Applied Special Technology, 1999). The initial universal design movement was developed to ensure "the design of products and environments that are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design" (The Center for Universal Design, 1997). Scholars at CAST viewed the basic principles of universal design and envisioned how these guidelines might also apply to the design of classroom and curricula.

The UDL model of instruction provides a blueprint to help educators generate curricula that utilize technology and include flexible methodology, materials, and assessment to make education more effective for and inclusive of all students (Center for Applied Special Technology, 1999). In the past, educators have always been taught to focus on fixing an individual student's ability to learn. UDL, on the other hand, shifts the focus from the individual student to the curriculum itself. Educators are asked to recognize that the barrier to learning is not inherent in the capabilities of their students, but instead presented by inflexible educational materials and design (Rose & Meyer, 2002).

The UDL model promotes three vital assumptions. First, all learners are unique and therefore have different needs for instruction. Every student in every classroom, regardless of ability level, should be provided with an equal opportunity to become involved with the curriculum. Next, instruction must be designed with all students in mind. Curricula should not need to be adjusted and tweaked as an after-thought for each individual student. Rather than adapting the curricula, educators can focus on the generation of materials and activities that reduce barriers to learning. Educators should prepare their lessons with built in flexibility that will increase overall effectiveness by allowing every student to access materials. Through the use of educational technology, educators can provide students greater accommodation and access to the curriculum. Media and interactive technologies offer students a plethora of ways in which to learn and subsequently demonstrate their acquired knowledge. Finally, and imperative for UDL, instructional design must be flexible. No instructional design can account for every variable, thus, educators must be willing to make modifications as they become necessary to assist learners through the education process. The UDL framework is constructed with the assumption that all students can learn, although they may learn in different ways and at different rates (Rose & Meyer, 2002).

Universal Design for Learning (UDL) should not be viewed as a method to “dumb-down” the curriculum or to teach to the least common denominator. Instead, UDL can be used to present challenges that will present themselves to each student at their level (Orkwis, 1999). UDL is the intersection where many education initiatives like “integrated units, multi-sensory teaching, multiple intelligences, differentiated instruction, use of computers in schools, performance based assessment, and others” (Rose & Meyer, 2002, p. 4) meet and merge into one model. UDL is a framework upon which many other constructivist pedagogies can hang. Used with other approaches, like differentiated instruction or active learning at the front end of design, the UDL model will save institutions and instructors a great deal of time and frustration at the back end (Rose & Meyer, 2002).

Proponents of UDL do not want educators and administrators to view this instructional design model as a burden or impossible task, but instead want them to recognize the added value UDL can present with a little initial investment. UDL is an instructional design model that can create instruction to teach students more than merely facts; UDL can be used to teach students how to learn (Rose & Meyer, 2002). As the composition of the classroom becomes more diverse and accountability mandates continue to challenge educators, UDL provides an instructional design model to meet both learner needs and education standards.

Purpose of Studying Universal Design for Learning in the College Classroom

Universal Design for Learning (UDL) is currently being implemented at a limited number of K-12 public schools and at a small number of colleges and universities throughout the United States as a potential method to reach an ever-more diverse student population. Studies regarding the use of UDL at the K-12 level of education indicate growing interest and legislative support for UDL nationwide (Müller & Tschantz, 2003).

While research has been conducted on the effects of UDL use in K-12 education, scant literature exists with regard to how UDL works in the postsecondary classroom. As a relatively new paradigm in the field of education, UDL remains a well-kept secret that should be explored and studied. If UDL works in practice as well as it reads in theory, every educator and education professional should be made aware of this instructional design method.

This descriptive case study addressed the following questions: (a) How and to what extent is UDL being implemented in the college classroom, and (b) what are students' perceptions of how UDL techniques affect their learning? The study provided valuable insights about what UDL techniques are being employed in higher education, and the impact various UDL strategies have according to student learners and the faculty member involved in the study.

Chapter Overview

This chapter outlined the history and development of Universal Design for Learning (UDL) and discussed the value of research in this relatively new area of education. Chapter 2 presents a review of pertinent UDL-related literature and discusses results from related research studies conducted on the use of UDL in K-12 schools. Chapter 3 details the research study to be conducted and outlines the proposed methodology to be used. Chapter 4 analyzes the results from the research conducted, and Chapter 5 provides a summary of interpretations and conclusions and suggests future research questions to further explore the use of UDL in postsecondary education.

Chapter 2

A Review of Relevant Literature

As a more diverse student population pervades the world of postsecondary education, institutions of higher education will need to evolve. Curriculum design is one vital facet of education that must be revised to meet the ever-changing needs of the modern student body. Universal Design for Learning (UDL) is an instructional design model that proponents claim has the power to transform traditional curricula into designs that are flexible enough to meet the widely divergent needs of exceedingly diverse audiences.

The construct of Universal Design for Learning (UDL) emerged from the earlier Universal Design movement that began in the field of architecture. In 1998, three universal design pioneers, Molly F. Story, James L. Mueller, and Ronald L. Mace, from the Center for Universal Design at North Carolina State University published *The Universal Design File: Designing for People of All Ages and Abilities* to introduce the concept of universal design to the world. Their volume on universal design is organized into four chapters that present a brief history of universal design, information on human abilities, the principles of universal design, and case studies related to the use of universal design.

The term "universal design" was coined by Ronald L. Mace, architect and founder of the federally funded Center for Accessible Housing, now known as the Center for Universal Design at North Carolina State University. Universal design is "the design of products and environments to be usable to the greatest extent possible by people of all ages and abilities," (Story, Mueller, & Mace, 1998, 2). According to Story, Mueller, and Mace, the idea for universal design had roots in demographic, legislative, economic, and social climate changes (1998).

Since the beginning of the 20th century, vast advances in medicine and technology altered the demographics of the United States. People are living longer lives. The conventional family structure no longer consists only of mom, dad, sisters, and brothers. Increasingly, households are comprised of generations from infants to senior citizens residing together in the same home. At the dawn of the 20th century, senior citizens and individuals with disabilities were true minorities as the average lifespan was only 47 years. "The average lifespan has increased to 76, largely due to healthier living, better medicine, and vaccines and sanitation that have virtually eliminated many killer infectious diseases" (Story, Mueller, & Mace, 1998, p. 6). The United States Census Bureau estimates that by the year 2020, over seven million people will be over the age of 85 (Story, Mueller, & Mace, 1998).

Parallel to these demographic shifts, the Civil Rights Movement and the Disability Rights Movement influenced social climate and federal legislation like the Architectural Barriers Act of 1968, Section 504 of the Rehabilitation Act of 1973, the Education for Handicapped Children Act of 1975, the Fair Housing Amendments of 1988, the Americans with Disabilities Act of 1990, and the Telecommunications Act of 1996 (Story, Mueller, & Mace, 1998). People began to recognize a need for products and services that are conceived for everyone regardless of ability level. Universal design standards give rise to no-step entrances, wider doors, larger rooms, and additional features that allow maximum use and access for everyone. For example, a slightly wider door would enable a mother with a baby stroller, a toddler in a walker, and an individual using a wheelchair to utilize the same entrance.

A team of engineers, environmental designers, and architects at the Center for Universal Design established seven principles for the universal design of products and environments (Story, Mueller, & Mace, 1998). Table 1 describes each of the principles of Universal Design as they apply to a lever door handle. The use of lever handles on doors and faucets is an example of universally designed products that suit a wide spectrum of human needs. For individuals with hand mobility limitations, such as arthritis, traditional doorknobs and turn-style handles can be difficult if not impossible to maneuver. Levers, on the other hand, allow the user to utilize any part of their body to open the door or turn on the faucet. While the lever is well suited to individuals with disabilities and an aging audience, the same lever handle is also appropriate for someone who does not have a free hand due to carrying heavy bags, pushing a baby stroller, or multitasking.

Table 1

Universal Design Principles

Principle	Description
Equitable use	A device, product, service, etc. should be useful and marketable to everyone, or as wide an audience as possible. The lever is a perfect example of a universally designed device. A wide range of users with many personal characteristics and levels of ability can use the lever handle.
Flexible use	A device, product, service, etc. should have multiple uses and not serve only one purpose. The lever can be used on doors, sinks, and other such areas where traditional handles or knobs can be replaced
Simple and intuitive	A device, product, service, etc. should be easy to use regardless of cognitive level of ability. The lever handle does not need to come with high tech detailed instructions in order for a user to figure out how to use it.
Perceptible information	A device, product, service, etc. should contain information that can be perceived via the senses. One can feel when the lever handle is moved, hear the click of the jam, and see when the lever is in position.
Tolerance for error	A device, product, service, etc. should have safety features that allow for some misuse

	without a high risk of injury or danger to the user. The lever handle poses little, if any, threat for danger.
Low physical effort	A device, product, service, etc. should not cause serious strain for users. The lever can be manipulated with very little physical strain on the user.
Size and space	A device, product, service, etc. should allow users enough space to approach, manipulate, and use. When positioned correctly on the door, the lever handle is reachable by most audiences.

The Center for Universal Design (1997)

While other articles and short documents can be found that discuss universal design, Story, Mueller, and Mace's 1998 work remains the authoritative example cited by all others in the field.

Since its inception, universal design has spread from the field of architecture into the manufacture of products, web design, engineering, and education. As the authors of "*Universal Design and Its Application in Educational Environments*" note, "a perusal of the current literature that pertains to UD in educational settings quickly results in an 'alphabet soup' jumble of terminology: UD, UDL, UDI, UID, UDE," (McGuire, Scott, & Shaw, 2006, p. 172). Universal Design (UD) has transformed into Universal Design for Learning, Universal Design of/for Instruction, Universal Instructional Design, and Universal Design in Education.

In *Universal Design in Education*, Frank Bowe, a professor of counseling, research, special education and rehabilitation (CRSR) in Hofstra University's School of Education and Allied Human Services, defines Universal Design in Education (UDE) as "the preparation of curriculum, materials and environments so that they may be used appropriately and with ease, by a wide variety of people" (Bowe, 1999). Bowe wrote his text to be used as a handbook for instructors involved in every level of education from kindergarten through advanced university programs. Much of his initial work was reflected in the ideas and writing of the scholars that followed him.

Educators at the University of Connecticut were the first to use the term Universal Design for Instruction (UDI) to describe the application of the seven basic principles of Universal Design to the educational environment. After some additional research was done, two additional principles were added to their list (see Table 2)(Faculty Ware, 2002). These nine principles focus heavily on physical access to and usability of the environment and technology.

Table 2

Principles of Universal Design for Instruction©

Principle	Definition
Equitable use	Instruction is designed to be useful and accessible by people with diverse abilities. Provide the same means of use for all students; identical whenever possible, equivalent when not.
Flexible use	Instruction is designed to accommodate a wide range of individual abilities. Provide choice in methods of use.
Simple and intuitive	Instruction is designed in a straightforward and predictable manner, regardless of the student's experience, knowledge, language skills, or current concentration level. Eliminate unnecessary complexity.
Perceptible information	Instruction is designed so that necessary information is communicated effectively to the student, regardless of ambient conditions or the student's sensory abilities.
Tolerance for error	Instruction anticipates variation in individual student learning pace and prerequisite skills.
Low physical effort	Instruction is designed to minimize nonessential physical effort in order to allow maximum attention to learning. Note: This principle does not apply when physical effort is integral to the essential requirements of a course.

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BY

SCOTT M. WYNDHAM

DISSERTATION ADVISOR: MICHAEL W. HARVEY

BALL STATE UNIVERSITY

DEPARTMENT OF SPECIAL EDUCATION

MUNCIE, INDIANA

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BY

Scott M. Wyndham

APPROVED BY:

______________________________ ______________
Committee Chairperson Date

______________________________ ______________
Committee Member Date

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Ball State University

Muncie, Indiana

July 2010

Dedicated to Autumn, Abigail, and Adelyn:

my princesses who are the loves of my life and

whose support has allowed me to reach this goal.

Abstract

Public policy and current educational reforms have challenged schools to close the achievement gap for all students, including those with disabilities as required under the No Child Left Behind Act (NCLB) of 2001. As schools seek to implement sound instructional practices for students, technology has become a dominant force in schools and society. The focus of improving instruction and meeting the needs of diverse learners has not yet blended with the technology capabilities that are more readily available in schools. Universal Design for Learning (UDL) seeks to build an inherent flexibility into the curriculum and to utilize technology to accommodate diverse learners.

The purpose of this study was to analyze how UDL training impacted school personnel's perceptions of inclusion, instruction, student engagement, and the use of technology to differentiate instruction to meet the needs of diverse learners. The sample consisted of faculty from 50 Indiana schools, and analysis was completed based on respondents' level of UDL training. Significant differences were found in perceptions that the primary responsibility for accommodating classroom activities for students with disabilities lies with the special education teacher, as well as whether accommodations designed for students with disabilities create increased opportunities for all learners. Significant differences were also found in how technology is used to provide choice and flexibility to students and differentiate instruction. There were significant differences in faculty perceptions that choice and technology impacted students' levels of engagement. Significant differences were found among variables based on respondents' categorization as general education or special education, as well as categorization as administrators or teachers.

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I would like to thank my committee chair, Dr. Michael Harvey, for his support and time in assisting me through this journey. I appreciate his guidance, expertise, and high expectations throughout my coursework and this study. I would also like to thank the other members of my committee, including Dr. Marilynn Quick, Dr. John Merbler, and Dr. Peggy Rice. At each step along the way, their support and eagerness about this project provided me needed encouragement.

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Finally, my wife, Autumn, has never wavered in her support of me. Throughout years of classes and seemingly endless hours of work, she has been my rock. I love you more than you know! My girls, Abigail and Adelyn, are truly daddy's little princesses and while they do not realize it yet, their hugs and kisses have kept me sane throughout this process!

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CHAPTER ONE

Introduction

Today's public schools are operating with unprecedented focus and pressure to address the academic needs of all learners, including those from various races, socioeconomic levels, abilities, and backgrounds. Thirty years of public policy and educational reforms have greatly changed the commitment of public schools to teach high standards to all learners (Gordon, 2009). While diversity has become the norm in public school, the curriculum and instruction have typically been designed to address the needs of the middle or average student while neglecting others (Rose & Gravel, 2009).

As diversity has increased in schools, so has technology. Technology has become a foundational component of American society. A survey conducted by the Pew Internet and American Life Project found that 73% of adults in America use computers (Rainie, 2004). Over 78% of children age 12-17 use the computer for online activities (Levin & Arafeh, 2002). Computers and technology have become woven into the fabric of American society. The average college freshman has spent over 10,000 hours playing video games, 20,000 hours watching television, and thousands of additional hours e-mailing, using the Internet, text-messaging, and other technology-based activities (Prensky, 2001). Compared to the 5,000 hours that students have spent reading (Prensky, 2001), technology's impact on today's young adults becomes evident.

Children engage with digital media up to six hours per day (Education Technology Council, 2007). However, Indiana students spend an average of between one and five hours per week using technology at school (Education Technology Council, 2007). Young adults in today's society are growing up as *digital natives* who are most comfortable in the fast-paced digital realm of computers, video games, and the Internet (Prensky, 2001). Young digital natives are not just more comfortable with technology than their parents and teachers, but digital technology has become an integral part of their lives and is incorporated throughout their daily routines (U.S. Department of Commerce, 2005). Educators need new strategies and tools that allow their students to experience teaching and learning in ways that correspond to the changing nature of the world in which students live (Solomon & Schrum, 2007).

As technology has expanded throughout society and generations of students can best be characterized as digital natives, many teachers and administrators have begun to utilize technology in attempts to improve the achievement of students. Over the last two decades, the numbers of computers in American schools has increased from 250,000 in 1983 to 8.6 million in 1998 (Becker, 2000). In 1997, American schools spent $3 billion on technology (Coley, Cradler, & Engle, 1997). According to the 2006 State Technology Report, schools contain an average of one instructional computer for every 3.8 students (The Information Edge, 2006). While there is disparity among funding for technology between schools (Coley et al., 1997), the Consortium for School Networking (n.d.) summarized their research findings and asserted, "Where there's a will to deepen schools' commitment to technology, there seems to be a way—and this seems more important than funding" (p. 5). Even while schools have increased the digital technologies available, 83% of students age 12-17 report that they use online tools more at home than at school (U.S. Department of Commerce, 2005).

While technology is more prevalent in schools, its role in the curriculum and pedagogy of American schools is varied and emerging. While technology has increased in schools and has changed the way people interact with their world, education has not yet embraced it to the same extent (Barton & Orwig, 1993; Solomon & Schrum, 2007). As schools strive to better prepare students for the future, they must utilize new strategies and tools to engage and prepare them for the technological world (Solomon & Schrum, 2007).

Public Policy

For students with disabilities, a driving force in furthering technology application in education has been the federal government's prompting and support, without which many of the advances made in technology would not have been possible (Blackhurst, 2005). When the Education for All Handicapped Children Act became law in 1975, its goal was to provide students with disabilities physical access to schools. While the goal of access to public schools has largely been achieved, the focus shifted to progress in the curriculum with the reauthorization of the Individuals with Disabilities Education Act (IDEA) of 1997 (Nolet & McLaughlin, 2000). The shift from access to progress in the general education curriculum was cemented with the 2004 reauthorization of IDEA (§ 300.320(a)), which specified:

> each child's IEP [individualized education plan] must include annual goals to enable the child to be involved in and make progress in the general education curriculum, and a statement of the special education and related services and supplementary aids and services to enable the child to be involved and make progress in the general education curriculum. (p. 46552)

Technology is incorporated into IDEA 2004 (§ 300.5) primarily through assistive technology and the requirement that IEP teams determine whether assistive technology is needed to increase, maintain, or improve the functional capabilities of a child with a disability. IEP teams must consider whether a technology device is necessary in order for the child to receive a free appropriate public education (FAPE). IDEA 2004 furthered the use of technology to create more accessible instructional materials with the National Instructional Materials Accessibility Standard (NIMAS). The NIMAS standard required states and local education agencies to "provide access to print instructional materials, including textbooks, in accessible media, free of charge, to blind or other persons with print disabilities" (34 CFR 300.172(e)(1)(ii)). NIMAS required local and state education agencies to provide digital file sets to ensure access to curricular materials for students with these disabilities (National Instructional Materials Accessibility Standard, 2006). Rose, Meyer, and Hitchcock (2005) asserted, "NIMAS will help to ensure that the ubiquitous textbook will be within reach of many students with disabilities at the critical point of instruction in an accessible and usable form" (p. 7).

While 30 years of legislation has been passed promoting access to public education for students with disabilities, little has been done to impact an inflexible curriculum that significantly limits teachers' abilities to address the needs of students in their classes (Meo, 2008). The original intent of IDEA to grant students with disabilities physical access to public schools left many students sitting in regular classrooms with little access to the general education curriculum (Nolet & McLaughlin, 2000). Simply being included in a general education classroom with no access to necessary supplementary aids and services is not sufficient to promote access to the general education curriculum for students with disabilities (Soukup, Wehmeyer, Bashinski, & Bovaird, 2007). Dolan and Hall (2001) discuss the "dreadful irony that students with disabilities have better access to school buildings than they do to the curricula within them" (p. 22). IDEA 1997, followed by the subsequent reauthorization in 2004, shifted the focus from *access* to *progress* in the general curriculum and created an environment in which teachers and administrators must become more adept at differentiating instruction and assessments to facilitate adequate progress. Educators are challenged to create the conditions for progress by maintaining high expectations for students with disabilities in the general education curriculum (Hehir, 2005) and by promoting flexibility in adjusting instruction to meet the needs of students (Nolet & McLaughlin, 2000).

Significant changes have occurred for students with disabilities and their expectations in the general curriculum from the initial passage of Education for All Handicapped Children Act in 1975 and the most recent reauthorization in IDEA 2004. Within those three decades, public education has received more focus and more public attention (Gordon, 2009). *A Nation at Risk: The Imperative for Educational Reform* was published in 1983 and threatened the impact that mediocrity in schools was having in America's place within the global community. Major focuses of *A Nation at Risk* included high academic standards, higher expectations, stronger content, more support for teachers, and more accountability (National Commission on Excellence in Education, 1983). The publication of *A Nation at Risk* led to a tremendous increase in state and local education reforms in the months and years following its release (Gordon, 2009).

In 1994, President Clinton's Goals 2000: Educate America Act placed additional focus on educational standards and accountability in the form of assessments in reading and mathematics. Following this initiative, the federal government began supporting more professional development for teachers and more technology supports in classrooms. Goals 2000 furthered the influence and control that the federal government had in public education (Gordon, 2009).

The reauthorization of IDEA in 1997 furthered the inclusion of students with disabilities in the standards-based reform movement through its emphasis on their inclusion in state accountability systems. IDEA 1997 required individual education plans (IEPs) to contain a statement of modifications needed in the administration of state or district assessments of student achievement. In circumstances where IEP teams determined a child would not participate in state or district assessments, IEPs must explain why assessments were not appropriate for that student (§300.347(a)(5)(i)). IEP teams could determine students would participate in an alternate assessment, and the performance of these students must also be reported along with their non-disabled peers (Nolet & McLaughlin, 2000). The inclusion of students with disabilities in state and local assessments initiated a stronger focus on the performance of students with disabilities while holding school districts accountable for their achievement (Hehir, 2005). The challenge of IDEA 1997 was that the requirement for students with disabilities to participate in state and local assessments was established before consideration had been given on how best to assess these students. Subsequent attention has been given to accommodations and modifications of assessments. However, further consideration of universally designed assessments may better anticipate the needs of students with disabilities (Hehir, 2009). Such consideration of UDL philosophies coupled with existing accountability measures would allow the focus on increased expectations for students with disabilities to be fully realized through assessments that are better equipped to assess student progress.

A significant milestone in the federal government's influence on education and in the history of students with disabilities' access to the general education curriculum was the No Child Left Behind Act of 2001 (NCLB). Prior to the mid-1990s, students with disabilities had largely been neglected in the standards-based reform movement (McGrew, Thurlow, & Spiegel, 1993; Nolet & McLaughlin, 2000). In its effort to leave no child behind, NCLB mandated that all public school students reach proficiency in reading-language arts and math by the 2013-2014 school year. The law specifically mandated that districts focus and report on progress of the following subgroups of students: economically disadvantaged, major racial and ethnic groups, students with disabilities, and students with limited English proficiency. NCLB further required teachers be highly qualified in the subjects they teach and based academic success on student performance on standardized tests (P.L. 107-110, NCLB).

Skrtic, Harris, and Shriner (2005) grant NCLB its proper significance when they assert, "The inclusion of students with disabilities in the outcomes-based accountability mechanism of NCLB is the most important advance in special education policy since enactment of the Education for All Handicapped Children Act of 1975" (p. 3). As schools seek to reach the 100% proficiency standard for even students with disabilities, the concepts of promoting access to the general education curriculum and differentiated instruction are critical to the professional development of teaching staff. Strangman and Dalton (2005) suggest, "Supported, adjustable digital learning environments can help ensure that every teacher reaches the goal of leaving no child behind" (p. 565).

With a growing research base in differentiated instruction and brain research, Universal Design for Learning (UDL) has emerged as a framework to serve as the "intersection of initiatives" (Rose & Meyer, 2002, p. 7) blending technology with other pedagogical practices, including learning styles, differentiated instruction, and cooperative learning. Coyne et al. (2006) indicate that “UDL synthesizes – or at the very least complements – a number of educational approaches” (p. 2). As mandates have increased for schools to demonstrate proficiency and progress for all students, the focus on examining instruction and access to learning has become more intense.

Universal Design for Learning stems from the universal design movement in architecture which arose following the passage of the Americans with Disabilities Act (ADA) of 1990. In order to meet ADA mandates, public buildings needed to be made accessible to individuals with disabilities with the addition of ramps, elevators, and wider doorways (Pisha & Coyne, 2001). Mace, Hardie, and Place (1996) coined the term “universal design” in architecture to describe consideration of the needs of the broadest range of users from the beginning of building design. Architects found it to be more cost effective and aesthetically pleasing to conceive, design, and construct buildings to accommodate the widest range of users. Rather than build subsequent adaptations to buildings to accommodate individuals with special needs after construction, proponents of universal design in architecture incorporated accessibility into the plans from the beginning stages (Rose & Meyer, 2002). The Center for Universal Design at North Carolina State University identified the following seven key principles of universal design: equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use (Sopko, 2008). The universal design movement in architecture "provides a blueprint for maximum inclusion of all people" (Mueller & Mace, 1998, p. 6). Applying this same blueprint and focus on accommodating the widest range of users within the field of education is the premise of UDL.

With a growing focus on instruction and curriculum, universal design or UDL has been referenced in several regulations and government reports over the last ten years, including the Higher Education Opportunity Act of 2008, the Assistive Technology Act of 2004, the President's Commission on Excellence in Special Education in 2002, and the reauthorization of IDEA in 2004. The Higher Education Opportunity Act of 2008 (HEOA) referenced UDL as a scientifically valid framework that

(A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and

(B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including those with disabilities and students who are limited English proficient [HEOA, P.L. 110-315, §103(a)(24)].

The Assistive Technology Act of 2004 referenced universal design and defined it in Section 3(a)(19) as:

> a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly accessible (without requiring

UNIVERSAL DESIGN FOR LEARNING PROCEDURES
IN SPECIAL EDUCATION TEACHER EDUCATION

Rebecca Elder Hinshaw

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Doctor of Philosophy
in the School of Education, Dept. of Curriculum and Instruction
Indiana University
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Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Doctoral Committee

Gretchen Butera, Ph.D.

Genevieve Manset-Williamson, Ph.D.

Thomas Brush, Ph.D.

David Flinders, Ph.D.

September 6, 2007

DEDICATION

I dedicate this to my loving parents, who taught me to do my best and leave the rest in the hands of Jesus. Their faith, love, prayers and encouragement sustained me.

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And last but not least, my son Craig is one of my strongest supporters. He has taught me that if you sow good seeds, you will reap a good harvest. His optimism and hard-working spirit are contagious. I am blessed by the love of all of my children and grandchildren. Their support and understanding has made this all possible.

ABSTRACT

Rebecca Elder Hinshaw

UNIVERSAL DESIGN FOR LEARNING PRINICIPLES IN SPECIAL EDUCATION TEACHER EDUCATION

The purpose of this qualitative case study was to illuminate the experiences of five LLTs as they participate in a re-designed Master's practicum for special education. The practicum addressed the teacher education program essential elements of inquiry, collaboration and reflection by employing Universal Design for Learning (UDL) concepts. The case study design utilized interviews and observations of the five LLT participants, the harvesting of the LLTs' practicum products and using inductive data analysis to uncover three emerging themes. Analysis indicated that most of the LLTs used reflection as a way to connect and jointly construct and process an understanding of the UDL concepts. The UDL projects and co-teaching mandate provided the LLTs with a chance to conduct action research and using UDL, meet the needs of their diverse students in the general education classroom. Two of the five LLTs had positive changes in their teaching as a result of the practicum and UDL, while the other three LLTs reported limited changes in their teaching as a result of the practicum and UDL.

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Introduction

Background

The efficacy of teacher education programs (TEPs) has been the focus of debate in recent years. Often held responsible for inadequate teacher and student performance, coursework in TEPs has been described as excessive, broken, and burdensome, by the Department of Education (U.S. Department of Education, 2002a). However, proponents for TEPs argue against these accusations with studies that suggest a positive relationship between TEP certified teachers and higher student test scores (Darling-Hammond, 2000; Lacsko-Kerr & Berliner, 2002). For example, a study by Lacsko-Kerr and Berliner (2002) noted that students taught by TEP certified teachers out-performed students taught by non-TEP certified teachers on standardized tests in language arts and reading.

Of equal concern for TEPs, particularly special education TEPs, are the changing dynamics of our nation's schools. These dynamics include: the varied educational experiences of limited license teachers (LLTs) who are working as special educators (Billingsley, 2004; Brownell, Hirsch, & Seo, 2004), the increase and diversity of students with disabilities being included in general education classrooms (U.S. Department of Education, 2002b), and the equity, accountability and research-to-practice expectations of the Individuals with Disabilities Educational Improvement Act of 2004 (IDEA, 2004) and the No Child Left Behind Act (NCLB, 2001). Of issue for special education TEPs is designing coursework that addresses these changing dynamics and provide future special

educators with experiences that allow them to transition what they have learned into practice (Billingsley, 2004).

Due to the continuing shortages of qualified special education teachers, our nation's schools are seeing an influx of LLTs working as special educators. Studies indicate that special education teacher shortages have been reported in ninety-eight percent of our schools (Boe, Cook, Bobbit, & Terhanian, 1998; ERIC, 2001), with school districts in rural areas reporting eighty percent (Knapczyk, Chapman, Rodes, & Chung, 2001). Research by McLeskey, Tyler & Flippin (2004) indicates that throughout the span of the 1990's, over 30,000 special education vacancies were filled by LLTs. This increase in LLTs has impacted special education TEPs. Many states require LLTs to pursue higher education coursework in special education as a condition of employment and licensing. Thus, Master's programs for special educators are seeing an increase in students from varied undergraduate backgrounds, taking classes to fulfill accreditation obligations (Knapczyk, et al., 2001). The diverse background knowledge and skills exemplified by LLTs create a unique learning and teaching environment for special education TEPs. The challenge for special education TEPs is to create coursework that recognizes the concerns and needs associated with LLTs.

It is well documented that the number of students being identified and receiving special education services in the general education classroom continues to grow, with recent data indicating that nearly six million students with disabilities spend a portion of their school day in inclusive settings (U.S. Dept. of Education, 2002b). Reports by the Study of Personnel Needs in Special Education (SPeNSE, 2000) indicate that an average general education classroom may contain three to four students identified as having a

disability. Further, with the implementation of NCLB (2001), all students are required to have access to the general education curriculum and be assessed using general education standards. The concern of meeting the needs of these increasing and diverse learners in the general education classroom is paramount. In response, special education TEPs must provide future special educators with coursework that allows them to meet the needs of students with disabilities in the general education classroom. Additionally, due to the inclusive setting that many special educators experience, it is important that special education TEPs prepare future special educators to work in collaborative roles.

Balancing legislative mandates with effective teacher education programming is a daunting task for special education TEPs. With the re-authorization of IDEA (2004) and its alliance with the equity, accountability and research-to-practice expectations of NCLB (2001), greater emphasis is put on special education TEPs to provide future and present educators with the training necessary to be in compliance with these government mandates, as they meet local needs for more special education teachers (Apple, 2001; Karger, 2004). For special education TEPs, the issue becomes not only providing future special educators with access to research, but also the opportunity to help bridge the gap between research and practice through their own research opportunities (Gersten & Smith-Johnson, 2001; Greenwood & Abbott, 2001).

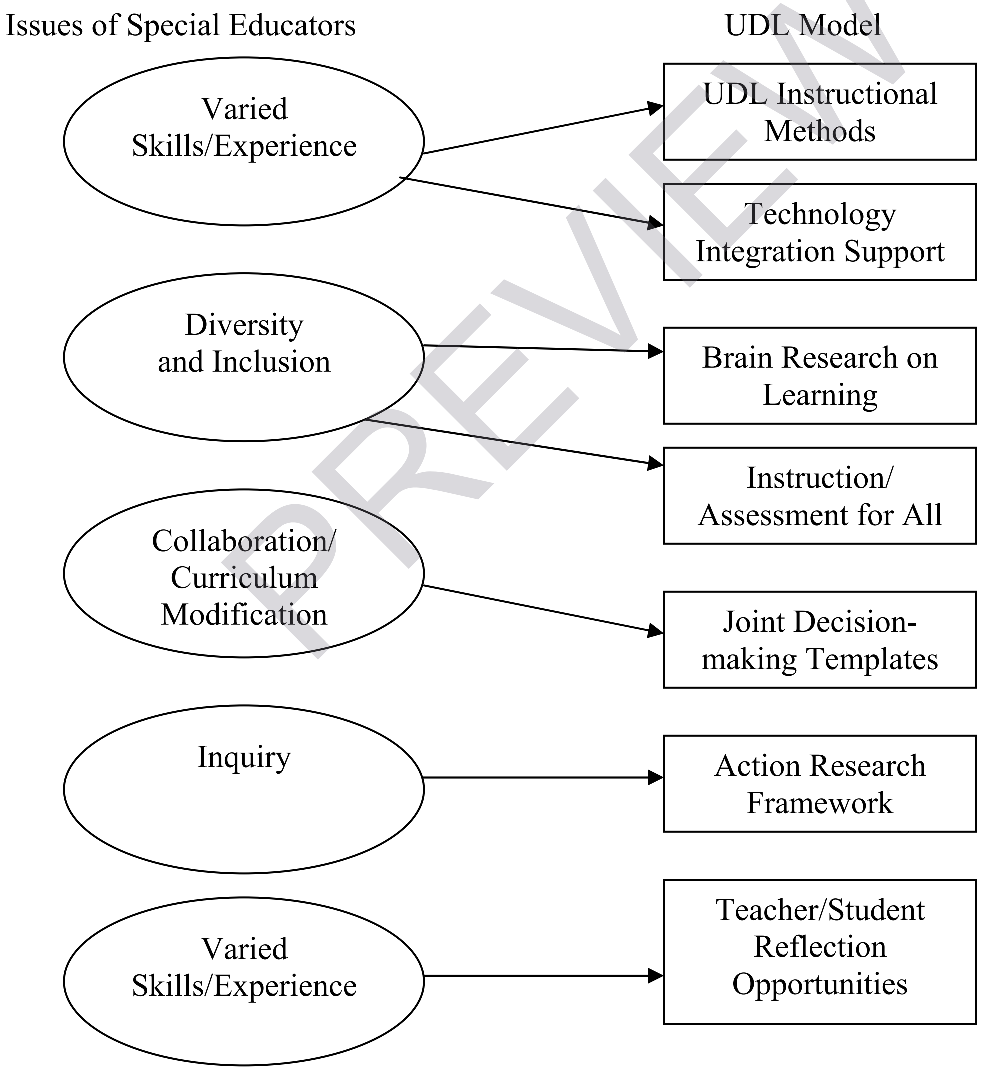
In response to these challenges, many TEPs have re-evaluated their programs (Barab, Barnett, & Squire, 2002; Lovingfoss, Molly, Harris, & Graham, 2001). To aid in this effort, teacher education reform rhetoric highlights reports and recommendations for best practices in teacher education. For example, Valli and Rennert-Ariev (2002) reviewed seven university reports and concluded that while performance based

assessment was an essential element of many quality programs, equally significant were reflection opportunities, field-based pedagogy and inquiry and collaboration experiences. Additional studies (Darling-Hammond, et al., 2000; Wideen, Mayer-Smith, & Moon, 1998) support the Valli and Rennert-Ariev (2002) findings and stress the importance of optimal field experiences supported by active faculty supervisors. Further studies that focus on the needs of special educators (Brownell, Ross, Colon, & McCallum, 2005; Fisher, Frey, & Thousand, 2003), indicate that special educators benefit from training in co-teaching and working collaboratively with general educators, adapting curriculum, and providing necessary supports to promote learning for students with disabilities in inclusive classrooms. The necessity for collaboration and co-teaching support is a common theme that is reflective of the complex and inclusive placements that special educators experience.

A promising approach to addressing the needs of special educators and students with disabilities in the general education classroom is Universal Design for Learning (UDL) (Jackson, Harper, & Jackson, 2001). The Center for Applied Special Technology (CAST) (http://www.cast.org) notes that, "UDL provides a blueprint for creating flexible goals, methods, materials, and assessments that accommodate learner differences." In designing their UDL model, CAST used information on brain processing and their own brain research. From this, they deducted that while each brain processes information in a unique manner, there are three specific areas or networks of the brain associated with learning. Their UDL model provides educators with ways to support students in each of these identified brain networks and also promotes the use of technology as a key component for teaching and learning in diverse classroom environments. The UDL

model aligns with NCLB (2001) and IDEA (2004) by promoting the use of ongoing assessment and usage of scientifically researched strategies to support students. IDEA mandates that universal design be used as an intervention to assist students with disabilities in participating more fully in the general education curriculum. Figure 1 represents how the UDL model addresses the described TEP issues of special educators in inclusive settings.

Figure 1.



Staff development programs in UDL have been implemented across the nation (CAST; http://www.cast.org) and in Indiana, 36 schools have received training in UDL through the Promoting Achievement through Technology and Instruction for All Students project (http://www.patinsproject.com). However, introducing UDL into a practicum in special education is a new idea.

Statement of the Problem

In order to redesign special education TEPs and address the urgent necessity for well-trained special educators to meet the needs of an increasingly diverse set of students with disabilities, it is important to examine how special educators translate what they learn to practice. Rich, descriptive data that portrays the experiences of the prospective special educators is needed. In an executive summary report on teacher education for the American Educational Research Association, Cochran-Smith & Zeichner (2005) point out the need for this type of case study research to shed light on " … what teacher education students learn from the opportunities they are provided within their programs" (p.30). Given the frequency with which LLTs are employed in special education, it may be especially important to understand how LLTs interpret what they learn in graduate coursework and translate it to practice.

The focus of this study was on the experiences of LLTs enrolled in a re-designed Master's practicum for special education at Indiana University, Bloomington (IUB). Through the practicum, the LLTs learned how to apply UDL in a co-teaching environment, including supporting diverse learners and using methods of inquiry and reflection.

Purpose of the Study

The purpose of the study was to illuminate the experiences of LLTs as they participated in a re-designed Master's practicum for special education that incorporated the UDL model. The practicum employed UDL concepts to address the TEPs essential elements of reflection, collaboration and inquiry.

Research Questions

1. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about reflection?
2. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about teaching diverse students?
3. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about collaboration?
4. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about methods of inquiry?
5. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about technology?

Significance of the Study

This study provides special education TEPs with insight into the experiences of LLTs as they participate in a practicum that uses the UDL model to support reflection, collaboration and inquiry. Since LLTs who are enrolled in Master's programs in special education have varied undergraduate backgrounds, skills, and teaching assignments, a portrait of the LLTs experiences as they participate in an IUB re-designed practicum in special education may prove valuable to understanding how learning is transferred to practice, particularly with TEP students with a variety of previous experiences.

For researchers interested in ways to bridge the gap between research and practice, the findings from this study provides information about the use of action research and the integration of UDL in a graduate course for special educators. A key element of UDL is the use of technology and this study provides information about how LLTs use technology to support their teaching. And finally, this study adds to the literature on developing the infrastructure in schools to meet the needs of students with disabilities in the general education classroom.

Chapter 2

Literature Review

Introduction

This chapter reviews literature pertinent to the questions posed in chapter one. It is divided into five sections. The focus of section one is on the role that reflection holds in teacher education, including online learning. Section two discusses co-teaching and students with disabilities and the UDL model. Section three summarizes studies on collaboration. Section four reviews the literature on inquiry and research. Section five examines technology usage in teaching.

Reflection

The ability to construct self-meaning from learning and teaching experiences is considered to be valuable to students in TEPs. Cochran-Smith & Lytle (1999) suggest that TEP coursework that promotes the analysis of everyday experiences and allows students to share those experiences within a supportive community of learners can be instrumental in establishing these reflective practices in future teaching. Putnam and Borko (2000) agree with Cochran-Smith and Lytle (1999) and through their study of adult learners, suggest that reflection should transcend self and also take into account the learners' physical and social environments-to help derive meaning of experiences. Brownell, Adams, Sindelar, Waldron and Vanhover (2006) revealed that quality teachers reflect on their teaching practice and make adjustments as necessary.

Beyond learning skills, TEP coursework that stress reflection may assist students in implementing innovative transformative practices. In a study by Lane, Lacefield-Parachini and Isken (2003), student teachers and their collaborative teachers were

instructed to reflect weekly on their classroom experiences and share their journals with one another. Through this supported interaction, the student teachers were able to instigate change in the way their collaborative teachers grouped and instructed students.

In addition, teachers and their students may benefit from the teachers' participation in shared reflection opportunities. Shank (2006) relates that teachers were able to discuss procedures, teaching techniques, and adaptation ideas when provided with opportunities for weekly reflection on their classroom practices.

Reflection is not limited to face-to-face courses and as more TEP courses are offered online, it is importance to provide students with an outlet to reflect on their experiences. For example, research by Meyers (2006) indicates that weekly online reflective journaling provided students participating in a field-based practicum, with an opportunity for self-evaluation and on-going feedback from their supervising instructor. Additionally, a study by Cook-Sather (2005) involving weekly e-mail contact between participants in an undergraduate TEP course, relates that the participants benefited from the consistent communication, space to exchange ideas and reflect on the course expectations and they also reported gaining an understanding of their classmates' lives and experiences through the online contact.

Co-teaching and UDL

An ever- increasing diverse population of students with disabilities receive services in general education classrooms, with co-teaching being the described method of special education service delivery. In one of the first article on co-teaching, Cook and Friend (1995) present five ways that co-teaching can occur in general education classrooms. In it, the authors describe various degrees of teacher-student interactions.

The co-teachers can share the responsibility of teaching the whole class instruction or one co-teacher can teach the majority of the class while the other provides alternative instruction to a smaller group of students. Both co-teachers can present identical instruction to each half of the classroom or students can move between learning stations and receive small group instruction from each co-teacher. And finally, one of the teachers can present the lesson while the other acts as a support. The authors suggest that the co-teaching model of teacher-student interaction should change in response to the needs of the students.

As co-teaching increases in inclusive classrooms, the benefits for students with disabilities continue to be an issue. The research on the advantages of co-teaching for students with disabilities has revealed mixed results. A recent example of this is a meta-analysis on co-teaching research conducted by Murawski, Weichel and Swanson (2001). Using quantitative methodology and effect size as an indicator of success, the authors discovered that only six of 89 co-teaching articles reviewed contained enough information to calculate effect size and when analyzed, the research revealed a range of effects. The highest effects were found in studies that contained dependent measures in language arts, with math measures having moderate effects and social aspects having lower effects. The authors believe that the variability is the result of the limited way in which the articles describe the actions of the co-teachers; yet, also suggest that additional research is needed to determine the effects of co-teaching on student achievement. A study conducted by Weiss (2004) notes the limited availability of research on effects of co-teaching on the skill acquisition of students with disabilities and also attributes this to an inadequate description of research methods. And while a study conducted by

Magiera and Zigmond (2005) agrees that there is inconsistent evidence for the benefits of co-teaching on skill acquisition of students with disabilities, the authors' research revealed that students with disabilities in eleven middle school co-teaching settings received a greater number of one-on-one teacher interactions as compared with similar students in teaching settings that included only a general educator.

While quantitative data on the effect of co-teaching is scarce and provides limited information, recent studies using qualitative research methods provide some insight into the co-teaching environment. For example, a study conducted by Jenkins, Antil, Wayne, and Vadasy (2003) used interview and observation data to examine co-teaching in 21 general education classrooms. The teachers in the study reported positive benefits for their students with disabilities. These benefits included an increase in self-esteem, access to an inclusive learning environment and the opportunity to participate and be successful in classroom activities. Another study by Mastropieri, Scruggs, Graetz, Norland, Gardizie and McDuffie (2005) had similar results concerning students with disabilities and provided examples of differentiated instructional supports for students in the general education classroom. Specifically, in one of the authors' case studies of a high school chemistry class, the co-teachers used peer tutoring and small group activities for lab work, rather than the general educator using whole class instruction with the special educator acting in a assisting role. The authors noted that the differentiated instruction and team-teaching model used by the co-teachers in the study provided the students with disabilities support in the general education classroom and allowed the co-teachers to interact equally with students.

A Phenomenological, Hermeneutic Case Study of Two Studio Learning Environments:
Reggio Emilia Pre-school *Atelier* and MIT TEAL Freshmen Studio Physics

By Christine Morano Magee

B.A., 1975, Mary Baldwin College
M.F.A., 1978, University of Virginia
M.A., 2001, Georgetown University

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Carol Kochhar-Bryant

Professor of Special Education

The Graduate School of Education and Human Development of The George Washington University certifies that Christine Morano Magee has passed the Final Examination for the degree of Doctor of Education as of June 15, 2009. This is the final and approved form of the dissertation.

A Phenomenological, Hermeneutic Case Study of Two Studio Learning Environments: Reggio Emilia Pre-School *Atelier* and MIT TEAL Freshmen Studio Physics

Christine Morano Magee

Dissertation Research Committee:

Carol A. Kochhar-Bryant, Professor of Special Education, Dissertation Director

Amy J. Mazur, Professor of Special Education, Committee Member

Pamela Leconte, Assistant Research Professor of Special Education, Committee Member

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Without art nature can never be perfect; and without nature art can claim no being. But our poet must beware that his study be not only to learn of himself; for he that shall affect to do that confesseth his ever having a fool to his master. He must read many, but ever the best and choicest; those that can teach him anything he must ever account his masters, and reverence.

Ben Johnson, *Timber or Discoveries: Made Upon Men and Matter*, 1641

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Abstract of Dissertation

A Phenomenological, Hermeneutic Case Study of Two Studio Learning Environments: Reggio Emilia Pre-school Atelier and MIT TEAL Freshmen Studio Physics

This qualitative, phenomenological, hermeneutic case study explores two studio learning environments: the Reggio Emilia inspired *Atelier* of School within School, at Peabody Elementary, Washington, DC and Massachusetts Institute of Technology (MIT) Freshmen Studio Physics, Technology Enabled Active Learning (TEAL). This study focuses on understanding processes through which learning takes place in two distinct studio learning environments, through observation of the instructional, attitudinal and architectural aspects of these classrooms and what occurs in them.

The study uses a confluence of theories producing a multi-faceted conceptual lens through which data is viewed for understanding. This lens includes: the Theory of Multiple Intelligences, the Ethic of Care, Universal Design for Learning and Studio Habits of Mind. The goal of the study was to create a rich description of each particular case in order to identify the structures and processes inherent in the respective models and their implications for learning, as well as their potential as learning environments for students with disabilities and "at-risk" students. This case study relied primarily on three sources of data: (a) observation, (b) interviews and (c) artifacts. Triangulation and analysis of data resulted in rich descriptive narrative of the two studios. The results of this study defined *Atelier* (studio) at School within School through four major emergent themes (a) student-centered learning, (b) community, (c) multiple ways of knowing, (d) comfort and care. The study defined the TEAL studio at MIT through five major emergent themes: (a) student-centered learning, (b) multiple ways of knowing, (c) collaboration and community, (d) comfort and care, (e) teacher dispositions.

A blended model of the cases concludes that studio, (a) offers student-driven hands-on active learning, (b) breaks down barriers between teachers and students, (c) is conducive to the development of caring peer relationships, (d) removes hierarchy and competition, (e) empowers students towards proficiency in the use of tools for learning, (f) offers multiple modalities for teaching and learning, (g) provides ongoing feedback and assessment, (h) learning is transparent and open-ended. This qualitative phenomenological, hermeneutic case study adds to the body of literature on studio settings as learning spaces and provides a platform for further research.

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PREVIEW

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Introduction

"The real voyage of discovery consists not in seeking new landscapes but in having new eyes." – Marcel Proust

One factor in a student's education that is noted as being important but is often peripheral to discussions of student achievement and student engagement in school is the role the classroom environment plays in teaching and learning (Gandini, 1998; Lackney, 1997; Van Note Chism & Bickford, 2003). A child spends approximately 32.5 hours a week in school, making it their home away from home (Juster, Ono & Stafford, 2004). The classroom environment, how it is physically arranged, how students and teachers interact with it and within it reflect a school's educational tenets (Cornell, 2002; Gandini, Hill, Cadwell & Schwall, 2005). Yet according to leading educational observers, many classrooms still adhere to a factory model, framed by pre-determined organizational structure, offering little flexibility in use of space and limited choices of how learning occurs within that space (Darling-Hammond, 2006; Steeves, 2006; Sullivan, 2007). There is an accumulating body of research evidence that finds that learning environments influence student engagement, achievement and persistence (Sullivan, 2007; Tanner, 2000).

The high school dropout rate in the United States is high, "almost one third of all public high school students—and nearly one half of all black, Hispanic and Native American students—fail to graduate…with their class" (Bridgeland, DiIulio, & Burke Morrison, 2006). It is important that educational research investigates practices, which exemplify holistic, caring, student centric models of education, which may help to keep students engaged and interested in school (Noddings, 2005). Research shows that obsolete classrooms and learning environments in need of repair send negative messages to students, while attention to the school environment results in an increase in student engagement and promotes student achievement (Jarman, Webb, & Chan, 2004). This research study is undertaken as a foundation for the future study of the possible beneficial outcomes, which may occur by the creation of an embedded studio classroom in high schools for students with disabilities and those students placed at risk.

Statement of the Problem

"The traditional scheme [of education] is, in essence, one of imposition from above and from outside"— John Dewey, Experience and Education.

This study explores learning environments that are flexible and innovative and move away from a traditional, factory model where education is delivered in a "one size fits all" assembly line, leading to uniform outcomes (Katz, 1987; Leland & Kasten, 2002). The goals of *No Child Left Behind* (NCLB, P. L. 107-110) that every child in America attains literacy at an early age in mathematics and reading are laudable. This current academic environment defines literacy through a narrow definition of intelligence that focuses on paper and pencil testing that does not explore if students are learning how to think beyond correct answers (Kohn, 2000). Research has shown that this situation has inhibited pedagogical innovations and narrows curricula to be test centric (Jennings & Rentner, 2006; Witte-Townsend & Hill, 2006). Further, this results in learning environments, which do not recognize individual needs or use of multiple pathways for learning and understanding (Gerstl-Pepin & Wodside-Jiron, 2005; Whitfield, 2005). Math and reading centric curricula of public elementary, middle and high schools in the U. S. place greater value on some subjects than others. This emphasis may result in missed opportunities to create holistic learning environments, which recognize the inter-connectedness and importance of the type of learning which occurs through exposure to a full complement of disciplines (Shantz & Rideout, 2003). The Center for Educational Policy reports that although standardized tests scores are rising, seventy one percent of schools are focusing attention and time to math and reading, limiting time spent on subjects not addressed in standardized testing (Jennings & Rentner, 2006). Funding cuts which narrow the curriculum and marginalize some disciplines, especially the arts, deprive students of the opportunity to explore and develop talents and skills not tested by the current education model and limit the opportunity for promising cognitive and pedagogical practices and research which learning in studio classes offer (Whitfield, 2005).

An American Architectural Foundation study on school design and student learning in the 21st century found that there is a need for research which studies innovative learning spaces, which keep pace with rapidly advancing technology and serve the changing needs of students (Sullivan 2007). Studio spaces create environments, which expand what may occur in a classroom by allowing traditional subjects to be explored in non-traditional ways (Gandini, 2004; Wilson, 1997). The theory, which under-girds learning in studio settings, moves away from a narrow view of disciplines taught in isolation towards a collaborative, project-based, learning experience which connects information across disciplines (Cadwell, 2003; Lackney, 1999).

Statistics for high school retention reflect that the current public education model needs attention. Over thirty percent of U.S. high school students fail to graduate, thirty five percent cite low grades as a "major factor" in their dropping out and forty-five percent of drop outs state that they felt that they had fallen too far behind academically to ever reach graduation (Bridgeland, 2006). Highly competitive classrooms "shatter conditions of trust, caring and cooperation that are most conducive to learning, innovation and creativity with the largest toll taken by those students who cannot compete" (Astuto, Clark, Read & McGree, 1994). The current academic climate does not include "care" as a tenet of education (Darling- Hammond, 2006). Research has found that an "ethics of caring" (Noddings, 2005), reflected in schools through the creation of trusting environments is key for student success (Noddings, 2005; Raider-Roth, 2005; Shapiro & Selkovich, 2001). There is value in exploring successful studio models across disciplines and educational levels that reflect a blending of cognitive theories and student-centric philosophies. Such models may be used as foundations for further study helping to identify supportive learning environments for students with disabilities and those placed at-risk.

Purpose and Research Questions

This foundational phenomenological, hermeneutic case study is being undertaken to explore two models of studio environments as classrooms, which are highly acclaimed as being student centered and successful for student learning, one in early childhood education, the other in higher education (Brown, 2006; Cadwell, 2003). The first is the pre-school *atelier*, or studio of Reggio Emilia, which offers nurturing student-centric learning through a theory of education, which considers the "environment the third teacher" and the arts as a way to develop new languages for learning (Gandini, Hill, Cadwell, & Schwall, 2005). The second is Technology Enabled Active Learning (TEAL) model of Freshmen Studio Physics at MIT, which creates a studio environment that, provides rich learning opportunities through interactive collaboration and cutting edge technology (Belcher, 2001). Promising solutions to our current high school crisis may be found by looking at non-traditional classroom models such as learning in studio. Research shows that Reggio Emilia pre-school *atelier*, and the higher education model of Technology Enabled Active Learning (TEAL) Freshman Studio Physics at MIT are models that succeed in engaging students through innovative use of space, tools and pedagogical practice (Belcher, 2001; Cadwell, 1997; Makhafula, 2005). Learning in studio empowers students to understand how to think and learn and discover their intellectual strengths through collaboration with others and interaction with materials (Belcher, 2001; Gandini, 2005; Hetland, Winner, Veenema, & Sheridan, 2007).

This study of two distinct studio spaces will use observation, student and teacher interviews, photographic images and artifacts to collect data, which will be triangulated and analyzed. The following exploratory questions will guide the research process.

Exploratory Questions: The exploratory questions guiding this study have the goal of attaining a holistic collective view of two distinct studio classrooms. The following questions and sub-questions will be explored during each case study.

1. What is occurring in two distinct studio learning environments?
    - How is meaning found in each of these studio environments?
    - What happens in each of these studio environments?
    - How is it happening?
    - Is each environment inclusive of all students?
2. What structures and processes are generated when the two studio learning spaces are viewed side by side?

LOYOLA UNIVERSITY CHICAGO

THE EFFECTS OF UNIVERSAL DESIGN FOR LEARNING AS A SECONDARY SUPPORT ON STUDENT BEHAVIORS AND ACADEMIC ACHIEVEMENT IN AN URBAN HIGH SCHOOL IMPLEMENTING PRIMARY LEVEL POSITIVE BEHAVIOR SUPPORT

A DISSERTATION SUBMITTED TO THE

FACULTY OF THE GRADUATE SCHOOL

IN CANDIDACY FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

PROGRAM IN EDUCATIONAL PSYCHOLOGY

BY

KELLY L. MORRISSEY

CHICAGO, ILLINOIS

MAY 2008

DISSERTATION APPROVAL SHEET

The dissertation submitted by Kelly L. Morrissey has been and approved by the following committee:

Hank Bohanon, Ph.D., Director
Associate Professor, School of Education
Loyola University Chicago

Pamela Fenning, Ph.D.
Associate Professor, School of Education
Loyola University Chicago

Meng-Jia Wu, Ph.D.
Assistant Professor, School of Education
Loyola University Chicago

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

6/ 9/08
Date

Director's Signature

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ABSTRACT

This study provides descriptive data on a pilot study investigating Universal Design for Learning (UDL) with Positive Behavior Support (PBS). The study took place in a diverse urban high school that was already implementing primary level PBS. Students at the school were continually taught expectations and acknowledged for good behaviors. The author utilized a purposive sample of four Literature classrooms. All four classrooms were inclusive (students with and without special needs were educated together). The classrooms were matched for comparison. Teachers from all four classrooms were given a refresher workshop and follow up support to help them continue to implement the primary (school-wide) PBS system in place. After three weeks of baseline data collection, the author provided training and follow up support to two of the four classroom teachers in UDL. The two treatment teachers implemented UDL lesson planning strategies that provided the students with flexible options for learning. Descriptive data suggest possible connections between UDL and improvements in student academic engagement and behaviors. Implications for future research are reported.

CHAPTER I

INTRODUCTION

Purpose of the Study

There are many challenges facing schools regarding the behavioral and academic needs of an increasingly diverse population of learners (Knitzer, 1993). Inclusion of students with disabilities is happening rapidly and schools need research-based methods to increase the success of all students and teachers (Lohrmann, Boggs, & Bambara, 2006). Urban high schools in particular have a heightened need for efficient and effective methods of discipline and instruction. Factors for these schools include: (a) the large and complex nature of the schools, (b) the number of students living with risk factors for school failure, such as poverty and violence (Bemak, Chi-Ying, & Siroskey-Sabdo, 2005), and (c) the pressure to increase graduation rates to promote a better quality of life for students (No Child Left Behind [NCLB], 2002; United States Department of Education, 2002). There is a dearth in the research examining interventions for urban high school settings.

Positive behavior support (PBS) and Universal design for learning (UDL) appear to be two compatible methods for improving student behaviors and academic achievement. There is; however, limited evidence regarding the efficacy of these methods in urban high school settings. The purpose of this study was to pilot a combined PBS and UDL program in Chicago Public urban high school inclusive classrooms to determine whether any effects can be shown on student behavior and academic success of students with and without special educational needs.

Statement of the Problem

Legislative Pressure

Schools are faced with increasing pressure from federal regulations. Policymakers are systematically increasing accountability in schools in hopes of improving public education in the United States (NCLB, 2001). These policies are requiring school personnel to (a) include students with special needs in the general education environment (Individuals with Disabilities Education Improvement Act [IDEIA], 2004; United States Department of Education, 2006), and (b) provide evidence of student progress through high stakes standardized testing (NCLB, 2001). These initiatives include challenging components for school staff members.

Inclusion. Federal law is increasing support of students with special needs accessing the general education curriculum in the least restrictive environment possible (IDEIA, 2004; United States Department of Education, 2006). While research indicates that the general education environment is often better for students with special needs and is not detrimental to students without special needs (Idol, 2006), it does pose new challenges for teachers. Students with disabilities are more likely to have behavioral difficulties, to have trouble engaging in school, and to move along the continuum from attendance problems to dropping out of school (Sinclair, Christenson, & Thurlow, 2005; Sutherland & Wehby, 2001). Teachers without special education training are now responsible for students with these increased academic, social, emotional and behavioral needs, and many of them feel anxious about this prospect.

Teachers often feel that they do not fully understand students' special needs, and that they do not have the training necessary to adequately educate included students (DeSimone & Parmar, 2006; Lohrmann, Boggs, & Bambara, 2006). Teachers report fewer feelings of attachment and more feelings of concern or rejection toward students with special needs included in their classes (Cook et al., 2000). Many teachers are supportive of inclusion, but feel that they are still learning how to effectively teach students of varying ability levels and manage problematic behaviors, and that they need support and instruction for themselves in order to become more effective (Idol, 2006). They have voiced a need for both school-wide initiatives to support them in including students with special needs, as well as situational individualized support for teachers encountering specific types of problems (Lohrmann, Boggs, & Bambara, 2006).

Given the increasing demand on general education faculty members to successfully include students with special needs, more research is needed on effective interventions. Many schools are moving toward second generation inclusion, in which students with special needs are not only in the general education classroom, but become part of the classroom. According to Turnbull, Turnbull, Shank, and Smith (2002) the four components of second generation inclusion include: (a) system-wide changes within the school to support inclusion, (b) teacher renewal through collaboration and partnership, (c) prioritizing intensive student needs and approaching the classroom with a flexible attitude to meet them, and (d) moving away from disability labels driving practices (p. 92). One possible way to move toward second generation inclusion and help teachers address increasingly diverse needs may be to embed the potentially effective academic flexibility found within UDL as part of the school-wide climate enhancement initiative known as

PBS. Both elements of this type of model (UDL and PBS) are described in detail in later sections.

High stakes testing. The No Child Left Behind Act of 2002 requires that all but one percent of students enrolled in public schools take part in national standardized tests of achievement. If student performance on such tests is below national goals, schools must implement plans to improve their performance. Punitive actions may be taken against staff if schools fail to meet adequate yearly progress goals on tests of achievement for more than three years. These punitive actions can include firing personnel and hiring new staff to take their places (NCLB, 2001; United States Department of Education, 2002). These tests have therefore come to be known as high stakes because of the potential consequences for poor performance by students. Many schools are feeling pressured to focus primarily on teaching students how to perform well on these tests. The inclusion of nearly all students' scores in the aggregation of test data provides added pressure. Only one percent of students in a school may partake in alternative assessments (NCLB, 2001), meaning students with disabilities are now being considered in the test results as well.

The pressure schools are under to help students perform on achievement tests has the potential to increase accountability and force school administrators and staff members to find empirically validated methods of instruction (NCLB, 2001; United States Department of Education, 2002). Conversely, this pressure may potentially tempt schools to adapt procedures that leave students with disabilities even further behind in the curriculum than they are at present (Stodden, Galloway, & Stodden, 2003). Teachers are in need of methods to teach all children in an effective way to ensure they have the knowledge and skills necessary to perform well on standardized tests and beyond.

Primary (school-wide) level PBS and UDL interventions, described in detail in later sections, may address some concerns related to high stakes testing. PBS has the potential to help students behave appropriately, and therefore spend more time in the classroom (Office of Special Education Programs, n.d.). The UDL process organizes effective adaptations into a logical and efficient method of planning lessons for students with varying ability levels (Center for Applied Special Technology, n.d.). Embedding UDL as a classroom level intervention within PBS may be a method for helping students with special needs to access the curriculum more efficiently. This in turn may be one way to help them achieve higher scores on standardized tests, but more in depth exploration is necessary in this area.

Managing Behaviors in Schools

Parents and teachers agree that good schools need effective behavior and discipline strategies. In addition to effective academic instructional strategies, middle and high school staff members teach students to follow rules of citizenship (Public Agenda, 2004). However, high schools in the United States are inundated with many difficulties handling student behaviors. These difficulties include: (a) classroom management, (b) handling large numbers of minor behavioral infractions, (c) addressing the connection between behavioral and academic problems and school failure, and (d) the repercussions of zero tolerance and overly punitive discipline policies (Public Agenda, 2004).

Classroom management. Teachers feel that the problem behaviors of a small portion of students are taking too much time away from instruction (Public Agenda, 2004). Part of this perception stems from the amount of documentation required for disciplinary action. Many teachers also feel that discipline problems are a pervasive concern in their schools. When teachers are unable to effectively manage classroom behaviors, they lose instructional time in a season of high stakes testing. Combining PBS with UDL at the classroom level has the potential to help alleviate some of these classroom management issues, but further examination is required.

Management of minor infractions. Schools appear to be adequately addressing serious concerns of violence and possession of drugs. It is the many minor infractions, such as high numbers of students arriving to class late; that are overwhelming the staff (Public Agenda, 2004). Approximately 30 percent of principals listed tardiness as a problem in their schools during the 1999-2000 school year (National Center for Educational Statistics, 2002). According to the National Center for Educational statistics, bullying, gang activity, disrespect, and verbal abuse of teachers were reported as discipline problems in schools. These problems were more frequently reported by schools with more than 1,000 students enrolled (Public Agenda, 2004).

Evidence indicates a direct connection between the number of minor behavioral infractions at a school and the likelihood that more serious and violent behaviors will take place. Large numbers of minor infractions also appear to negatively influence perceptions of school safety (National Center for Educational Statistics, 2003; Skiba & Peterson, 2000; Skiba & Rausch, 2006). There is a need for more efficient, effective strategies for preventing and responding to problem behaviors in schools. Students with academic challenges such as learning disabilities may be communicating frustration through these high numbers of minor infractions (Burke, Hagan-Burke & Sugai, 2003), especially the avoidance of class by coming late or cutting altogether. Providing a more accessible curriculum paired with teaching and acknowledging of behaviors could be achieved by embedding UDL within PBS. This approach may provide some preventative measures that could help to reduce the large number of behavioral incidents occurring within a school.

Problem behavior and school failure. Difficulties in handling discipline should be a major concern for schools, as there is a direct link between behavioral problems and academic failure. Not only do students with low grades tend to demonstrate more behavioral infractions later in school than their peers, but as students act out behaviorally, their grades tend to drop (McIntosh et al., 2006; Meyers et al., 1987; Roberts et al., 2001). With increasing pressure to help students perform academically (NCLB, 2001; United States Department of Education, 2002), school personnel need to find ways to manage behaviors and keep students in the classroom and engaged.

Students with behavior problems are ultimately at-risk for failing to complete school altogether. Office discipline referrals and attendance data can be used to predict school failure at an early age. Students with multiple office discipline referrals for behavioral incidents and students with poor attendance are at risk for poor grades and dropping out of school (Lehr, Sinclair, & Christenson, 2004; Tobin, Sugai, & Colvin, 2000; Walker et al., 2005). Successfully completing high school drastically increases employability (United States Department of Labor, n.d.; Viadero, 2001) and therefore has a major impact on quality of life and socioeconomic status. Students at risk for school failure need to be served in such a way as to keep them enrolled, engaged, and supported in order to help them graduate and find satisfactory employment.

Attendance and graduation rates, some times referred to as "promotion power of schools," in many schools are problematic. The national graduation rate is difficult to exact from conflicting reports. According to the U.S. Department of Education, as of 2003 an estimated 15 percent of United States Citizens over the age of 25 had not completed high school (n.d.). This is one of the more generous estimates, and yet still indicates that hundreds of thousands of individuals do not earn a high school diploma. A study conducted through the Center for Civic Innovation estimated a much lower graduation rate at 71 percent as of 2002 (Greene & Winters, 2005). Given the aforementioned information regarding graduation and employability, many of these individuals who do not complete high school are likely to be unemployed. Increasing high school graduation rates (and therefore increasing the employability of larger numbers of individuals) could have a major effect on the students and society. School personnel are in need of strategies to help students at risk for school failure to find success and avoid dropping out before graduation. Combining PBS with UDL may be a preventative model for addressing both the behavioral and academic needs of students at risk for school failure, but needs to be examined.

Zero tolerance policies. Thus far, many schools have addressed concerns about handling discipline by creating increasingly punitive reactionary policies. These policies have led to the exacerbation of numerous lower level incidents, such as sharing over the counter pain medication or holding up a paper gun, resulting in suspension or expulsion of students (Skiba & Knesting, 2001; Skiba & Rausch, 2006; Tebo, 2000). Further, suspension is widely used in reaction to minor incidents such as attendance problems (Skiba & Knesting, 2001; Skiba & Rausch, 2006). A recent analysis of discipline policies revealed that the vast majority of techniques being utilized in schools are punitive, and many schools have little to no proactive measures embedded in their policies (Fenning, Theodos, Benner, & Bohanon-Edmonson, 2004). While consequences for problem behaviors are necessary, the steady occurrence of several types of school crime, violence, and misbehavior (National Center for Educational Statistics, 2003) indicates that the current punitive measures to change behaviors are ineffective.

The results of current research indicate that an over reliance on punitive policies is ineffective at changing behavior (Reynolds et al., 2006). Students who have been suspended often repeat the same offense, and are more likely to drop out of school than their peers (Skiba & Knesting, 2001; Skiba & Rausch, 2006). Also, coercive methods of discipline can trigger counter-aggressive behaviors in students when used in the absence of reinforcement (Mayer & Sulzer-Azaroff, 1991, pp. 559-580). These punitive policies have become widely utilized after highly publicized incidents like the school shootings in Columbine, Colorado in 1999. Some school administrators may attempt to reassure parents and students with punitive and zero tolerance initiatives. The danger lies in the fact that these practices can trigger worse outcomes.

Zero tolerance discipline policies offer a window for excluding students from the educational system in a discriminatory way. Students from minority backgrounds, males, and students who are low academic achievers are much more likely to be suspended or expelled than their peers (Skiba et al., 2002; Skiba & Peterson, 2000; Skiba & Rausch, 2006). This trend feeds into the direct pipeline of young men who struggle in school and who are of minority descent into the correctional system (Noguera, 2003). Schools appear to be in need of proactive, efficient methods of discipline in order to help all students, regardless of race, gender, or ability level succeed and stay in school, and therefore have a chance to become satisfied and productive members of society. Both PBS and UDL are designed to affect all students positively. They are proactive measures geared toward helping students succeed in school before their behaviors and academic needs have reached intense levels (Center for Applied Special Technology, n.d.; Office of Special Education Programs, n.d.). Embedding UDL as a support within a PBS framework appears to be a logical proactive alternative to zero tolerance discipline policies, but investigation is warranted.

Theoretical Rationale

Principles of Behavior

Schools are struggling with behavior management in part because the techniques being used are not compatible with some basic principles of behavior (Mayer & Sulzer-Azaroff, 1991, pp. 559-580; Skiba & Peterson, 2000; Skiba & Rausch, 2006). The PBS approach was developed from a technology of behavior (Carr et al., 2002). A basic overview of the fundamental principles of behavior is necessary in order for a thorough explanation of PBS to be conveyed. A description of PBS follows immediately after this discussion of the guiding principles of behavior upon which PBS was based. These principles include the use of: (a) instruction, (b) reinforcement, and (c) punishment.

Instruction. Instruction is an important element of learning new behaviors. All students should be directly taught the behavioral expectations for the building (Glover, 2004; Office of Special Education Programs, n. d.). In order for students to perform well behaviorally, they must clearly understand what adults in the building are going to be looking for.

Reinforcement. Reinforcement is often utilized in order to encourage the demonstration of newly learned behaviors. Reinforcement is any type of stimulus or consequence following a behavior that increases the likelihood a behavior will be repeated. Positive reinforcement is any object or action that, *when presented to a person* after a behavior, *increases the occurrence of that behavior* (Skinner, 1938, p. 66). A very simple example is providing a toddler with a piece of candy when they ask saying, "Please." The toddler is then likely to say, "Please" the next time they want candy. Positive reinforcement can take the shape of concrete rewards like money, prizes, or food, but it can also be praise, hugs, smiles or any social interaction that a person finds rewarding or pleasant.

Negative reinforcement is another tool for shaping behaviors, but is not to be confused with punishment. Negative reinforcement occurs when an unpleasant action, object or situation is *taken away after* the learner demonstrates a behavior, therefore *increasing the likelihood that behavior will occur again* (McComas, Hoch, Paone, & El-Roy, 2000; Skinner, 1938, p. 66). An example is verbally correcting a child to throw away their trash until he or she completes this task. The child is happy to be rid of the verbal correction, and has learned that throwing away trash will result in the avoidance of verbal correction. The important factor in determining whether a situation involves reinforcement or punishment is to observe the learner's behavior. If the behavior continues or increases, reinforcement is being utilized. If the behavior decreases, a punishment is present.

Reinforcement can be used to shape behaviors as well as to increase the frequency of already existing behaviors. If a learner is demonstrating a desirable behavior, only infrequently, positive or negative reinforcement can be applied at times the behavior is noted. If reinforcement is randomly presented immediately following the target behavior, the behavior is likely to increase (Skinner, 1938, p. 66). Focusing on increasing desirable behaviors is often a successful approach to behavior modification.

Punishment. Many discipline programs rely on punitive practices (Fenning, Theodos, Benner, & Bohanon-Edmonson, 2004; Fenning et al., in press). Punishment is defined as a stimulus that *follows a behavior* and *decreases the likelihood* of the behavior occurring again (Horner et al., 2005). While it is important for learners to understand consequences for both positive and negative behaviors, an over reliance on punitive consequences to modify behaviors can lead to some undesirable side effects. Often punishment only works when the punisher is present. It may encourage students to become sneaky (Sidman, 1989, pp. 89-108). The punisher can be associated with the aversive stimulus, so punishment alone can lead to a breakdown in relationships between students and faculty, even leading to revenge-seeking behavior (Mayer & Sulzer-Azaroff, 1991, pp. 559-580). Also, punishment alone only teaches what not to do; it does not provide lessons in alternative behaviors. Finally, it is often difficult to come up with a stimulus that is punishing (Sidman, 1989, pp. 58-68). Students may be faced with such aversive situations outside of school that they become desensitized to any type of punishment that can ethically be endorsed in schools.

UNIVERSAL DESIGN FOR LEARNING PROCEDURES
IN SPECIAL EDUCATION TEACHER EDUCATION

Rebecca Elder Hinshaw

Submitted to the faculty of the University Graduate School
in partial fulfillment of the requirements
for the degree
Doctor of Philosophy
in the School of Education, Dept. of Curriculum and Instruction
Indiana University
May, 2008

Accepted by the Graduate Faculty, Indiana University, in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

Doctoral Committee

Gretchen Butera, Ph.D.

Genevieve Manset-Williamson, Ph.D.

Thomas Brush, Ph.D.

David Flinders, Ph.D.

September 6, 2007

DEDICATION

I dedicate this to my loving parents, who taught me to do my best and leave the rest in the hands of Jesus. Their faith, love, prayers and encouragement sustained me.

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I gratefully acknowledge the dedication, support and kindness of my committee chair, Gretchen Butera. She introduced me to the art of qualitative research and the sweat equity that comes from analyzing and listening to the data. She was there at the conception of this research. She wisely advised and consoled me along the way and stood by me through revisions and bouts of procrastination. I am sincerely grateful for her kindness, wisdom and innate ability to bring out the best in me. She is a valued friend and colleague.

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My final acknowledgment goes to my children. My daughter, Nicole is my inspiration and heart. I followed her to Indiana University where she received her Doctor of Optometry and now I too will have a Doctorate from Indiana University. Her positive attitude and love inspires me. My son, Brian is the light in my eye. Being an avid reader, he encouraged and motivated me to do my best work. He made me smile and when times got tough, I would look at one of his early drawings and be reminded to "never give up."

And last but not least, my son Craig is one of my strongest supporters. He has taught me that if you sow good seeds, you will reap a good harvest. His optimism and hard-working spirit are contagious. I am blessed by the love of all of my children and grandchildren. Their support and understanding has made this all possible.

ABSTRACT

Rebecca Elder Hinshaw

UNIVERSAL DESIGN FOR LEARNING PRINICIPLES IN SPECIAL EDUCATION TEACHER EDUCATION

The purpose of this qualitative case study was to illuminate the experiences of five LLTs as they participate in a re-designed Master's practicum for special education. The practicum addressed the teacher education program essential elements of inquiry, collaboration and reflection by employing Universal Design for Learning (UDL) concepts. The case study design utilized interviews and observations of the five LLT participants, the harvesting of the LLTs' practicum products and using inductive data analysis to uncover three emerging themes. Analysis indicated that most of the LLTs used reflection as a way to connect and jointly construct and process an understanding of the UDL concepts. The UDL projects and co-teaching mandate provided the LLTs with a chance to conduct action research and using UDL, meet the needs of their diverse students in the general education classroom. Two of the five LLTs had positive changes in their teaching as a result of the practicum and UDL, while the other three LLTs reported limited changes in their teaching as a result of the practicum and UDL.

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Introduction

Background

The efficacy of teacher education programs (TEPs) has been the focus of debate in recent years. Often held responsible for inadequate teacher and student performance, coursework in TEPs has been described as excessive, broken, and burdensome, by the Department of Education (U.S. Department of Education, 2002a). However, proponents for TEPs argue against these accusations with studies that suggest a positive relationship between TEP certified teachers and higher student test scores (Darling-Hammond, 2000; Lacsko-Kerr & Berliner, 2002). For example, a study by Lacsko-Kerr and Berliner (2002) noted that students taught by TEP certified teachers out-performed students taught by non-TEP certified teachers on standardized tests in language arts and reading.

Of equal concern for TEPs, particularly special education TEPs, are the changing dynamics of our nation's schools. These dynamics include: the varied educational experiences of limited license teachers (LLTs) who are working as special educators (Billingsley, 2004; Brownell, Hirsch, & Seo, 2004), the increase and diversity of students with disabilities being included in general education classrooms (U.S. Department of Education, 2002b), and the equity, accountability and research-to-practice expectations of the Individuals with Disabilities Educational Improvement Act of 2004 (IDEA, 2004) and the No Child Left Behind Act (NCLB, 2001). Of issue for special education TEPs is designing coursework that addresses these changing dynamics and provide future special

educators with experiences that allow them to transition what they have learned into practice (Billingsley, 2004).

Due to the continuing shortages of qualified special education teachers, our nation's schools are seeing an influx of LLTs working as special educators. Studies indicate that special education teacher shortages have been reported in ninety-eight percent of our schools (Boe, Cook, Bobbit, & Terhanian, 1998; ERIC, 2001), with school districts in rural areas reporting eighty percent (Knapczyk, Chapman, Rodes, & Chung, 2001). Research by McLeskey, Tyler & Flippin (2004) indicates that throughout the span of the 1990's, over 30,000 special education vacancies were filled by LLTs. This increase in LLTs has impacted special education TEPs. Many states require LLTs to pursue higher education coursework in special education as a condition of employment and licensing. Thus, Master's programs for special educators are seeing an increase in students from varied undergraduate backgrounds, taking classes to fulfill accreditation obligations (Knapczyk, et al., 2001). The diverse background knowledge and skills exemplified by LLTs create a unique learning and teaching environment for special education TEPs. The challenge for special education TEPs is to create coursework that recognizes the concerns and needs associated with LLTs.

It is well documented that the number of students being identified and receiving special education services in the general education classroom continues to grow, with recent data indicating that nearly six million students with disabilities spend a portion of their school day in inclusive settings (U.S. Dept. of Education, 2002b). Reports by the Study of Personnel Needs in Special Education (SPeNSE, 2000) indicate that an average general education classroom may contain three to four students identified as having a

disability. Further, with the implementation of NCLB (2001), all students are required to have access to the general education curriculum and be assessed using general education standards. The concern of meeting the needs of these increasing and diverse learners in the general education classroom is paramount. In response, special education TEPs must provide future special educators with coursework that allows them to meet the needs of students with disabilities in the general education classroom. Additionally, due to the inclusive setting that many special educators experience, it is important that special education TEPs prepare future special educators to work in collaborative roles.

Balancing legislative mandates with effective teacher education programming is a daunting task for special education TEPs. With the re-authorization of IDEA (2004) and its alliance with the equity, accountability and research-to-practice expectations of NCLB (2001), greater emphasis is put on special education TEPs to provide future and present educators with the training necessary to be in compliance with these government mandates, as they meet local needs for more special education teachers (Apple, 2001; Karger, 2004). For special education TEPs, the issue becomes not only providing future special educators with access to research, but also the opportunity to help bridge the gap between research and practice through their own research opportunities (Gersten & Smith-Johnson, 2001; Greenwood & Abbott, 2001).

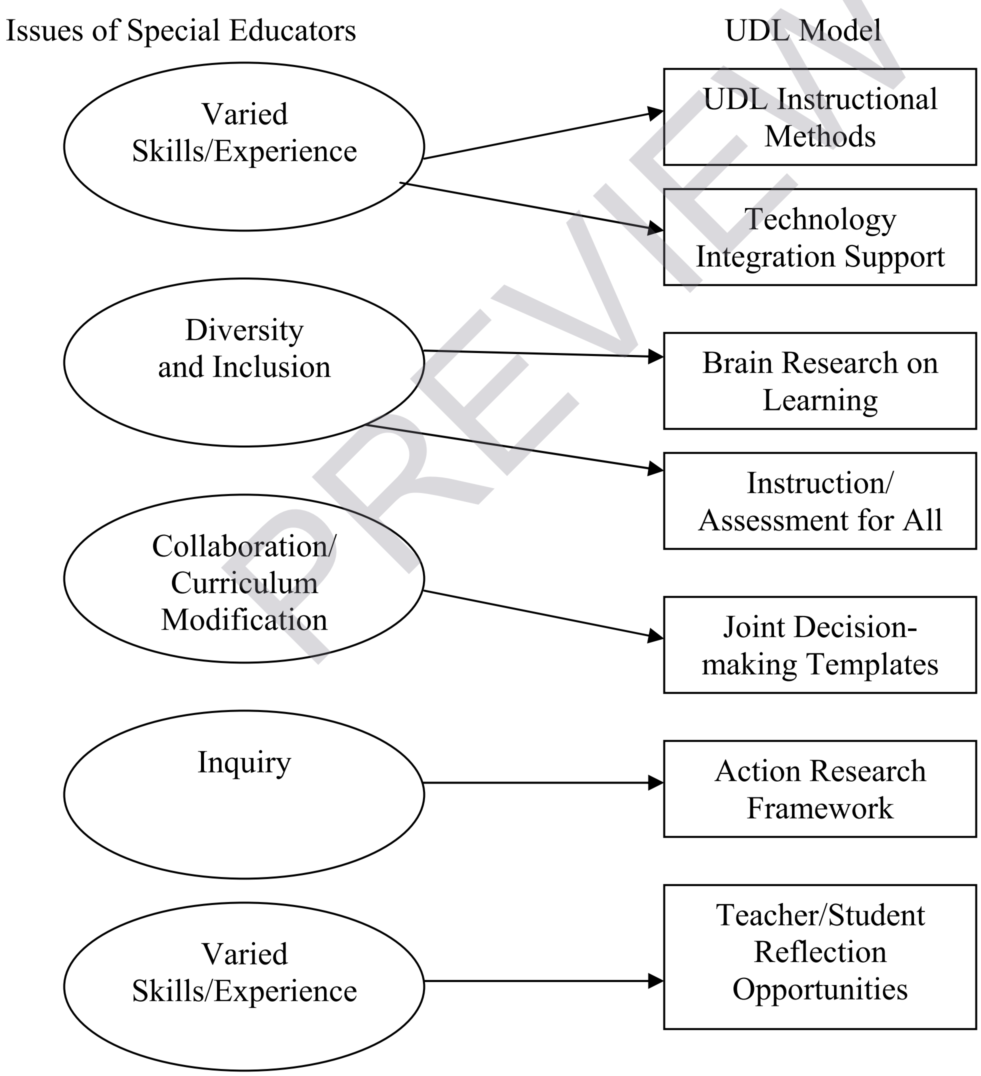
In response to these challenges, many TEPs have re-evaluated their programs (Barab, Barnett, & Squire, 2002; Lovingfoss, Molly, Harris, & Graham, 2001). To aid in this effort, teacher education reform rhetoric highlights reports and recommendations for best practices in teacher education. For example, Valli and Rennert-Ariev (2002) reviewed seven university reports and concluded that while performance based

assessment was an essential element of many quality programs, equally significant were reflection opportunities, field-based pedagogy and inquiry and collaboration experiences. Additional studies (Darling-Hammond, et al., 2000; Wideen, Mayer-Smith, & Moon, 1998) support the Valli and Rennert-Ariev (2002) findings and stress the importance of optimal field experiences supported by active faculty supervisors. Further studies that focus on the needs of special educators (Brownell, Ross, Colon, & McCallum, 2005; Fisher, Frey, & Thousand, 2003), indicate that special educators benefit from training in co-teaching and working collaboratively with general educators, adapting curriculum, and providing necessary supports to promote learning for students with disabilities in inclusive classrooms. The necessity for collaboration and co-teaching support is a common theme that is reflective of the complex and inclusive placements that special educators experience.

A promising approach to addressing the needs of special educators and students with disabilities in the general education classroom is Universal Design for Learning (UDL) (Jackson, Harper, & Jackson, 2001). The Center for Applied Special Technology (CAST) (http://www.cast.org) notes that, "UDL provides a blueprint for creating flexible goals, methods, materials, and assessments that accommodate learner differences." In designing their UDL model, CAST used information on brain processing and their own brain research. From this, they deducted that while each brain processes information in a unique manner, there are three specific areas or networks of the brain associated with learning. Their UDL model provides educators with ways to support students in each of these identified brain networks and also promotes the use of technology as a key component for teaching and learning in diverse classroom environments. The UDL

model aligns with NCLB (2001) and IDEA (2004) by promoting the use of ongoing assessment and usage of scientifically researched strategies to support students. IDEA mandates that universal design be used as an intervention to assist students with disabilities in participating more fully in the general education curriculum. Figure 1 represents how the UDL model addresses the described TEP issues of special educators in inclusive settings.

Figure 1.



Staff development programs in UDL have been implemented across the nation (CAST; http://www.cast.org) and in Indiana, 36 schools have received training in UDL through the Promoting Achievement through Technology and Instruction for All Students project (http://www.patinsproject.com). However, introducing UDL into a practicum in special education is a new idea.

Statement of the Problem

In order to redesign special education TEPs and address the urgent necessity for well-trained special educators to meet the needs of an increasingly diverse set of students with disabilities, it is important to examine how special educators translate what they learn to practice. Rich, descriptive data that portrays the experiences of the prospective special educators is needed. In an executive summary report on teacher education for the American Educational Research Association, Cochran-Smith & Zeichner (2005) point out the need for this type of case study research to shed light on " … what teacher education students learn from the opportunities they are provided within their programs" (p.30). Given the frequency with which LLTs are employed in special education, it may be especially important to understand how LLTs interpret what they learn in graduate coursework and translate it to practice.

The focus of this study was on the experiences of LLTs enrolled in a re-designed Master's practicum for special education at Indiana University, Bloomington (IUB). Through the practicum, the LLTs learned how to apply UDL in a co-teaching environment, including supporting diverse learners and using methods of inquiry and reflection.

Purpose of the Study

The purpose of the study was to illuminate the experiences of LLTs as they participated in a re-designed Master's practicum for special education that incorporated the UDL model. The practicum employed UDL concepts to address the TEPs essential elements of reflection, collaboration and inquiry.

Research Questions

1. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about reflection?
2. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about teaching diverse students?
3. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about collaboration?
4. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about methods of inquiry?
5. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about technology?

Significance of the Study

This study provides special education TEPs with insight into the experiences of LLTs as they participate in a practicum that uses the UDL model to support reflection, collaboration and inquiry. Since LLTs who are enrolled in Master's programs in special education have varied undergraduate backgrounds, skills, and teaching assignments, a portrait of the LLTs experiences as they participate in an IUB re-designed practicum in special education may prove valuable to understanding how learning is transferred to practice, particularly with TEP students with a variety of previous experiences.

For researchers interested in ways to bridge the gap between research and practice, the findings from this study provides information about the use of action research and the integration of UDL in a graduate course for special educators. A key element of UDL is the use of technology and this study provides information about how LLTs use technology to support their teaching. And finally, this study adds to the literature on developing the infrastructure in schools to meet the needs of students with disabilities in the general education classroom.

Chapter 2

Literature Review

Introduction

This chapter reviews literature pertinent to the questions posed in chapter one. It is divided into five sections. The focus of section one is on the role that reflection holds in teacher education, including online learning. Section two discusses co-teaching and students with disabilities and the UDL model. Section three summarizes studies on collaboration. Section four reviews the literature on inquiry and research. Section five examines technology usage in teaching.

Reflection

The ability to construct self-meaning from learning and teaching experiences is considered to be valuable to students in TEPs. Cochran-Smith & Lytle (1999) suggest that TEP coursework that promotes the analysis of everyday experiences and allows students to share those experiences within a supportive community of learners can be instrumental in establishing these reflective practices in future teaching. Putnam and Borko (2000) agree with Cochran-Smith and Lytle (1999) and through their study of adult learners, suggest that reflection should transcend self and also take into account the learners' physical and social environments-to help derive meaning of experiences. Brownell, Adams, Sindelar, Waldron and Vanhover (2006) revealed that quality teachers reflect on their teaching practice and make adjustments as necessary.

Beyond learning skills, TEP coursework that stress reflection may assist students in implementing innovative transformative practices. In a study by Lane, Lacefield-Parachini and Isken (2003), student teachers and their collaborative teachers were

instructed to reflect weekly on their classroom experiences and share their journals with one another. Through this supported interaction, the student teachers were able to instigate change in the way their collaborative teachers grouped and instructed students.

In addition, teachers and their students may benefit from the teachers' participation in shared reflection opportunities. Shank (2006) relates that teachers were able to discuss procedures, teaching techniques, and adaptation ideas when provided with opportunities for weekly reflection on their classroom practices.

Reflection is not limited to face-to-face courses and as more TEP courses are offered online, it is importance to provide students with an outlet to reflect on their experiences. For example, research by Meyers (2006) indicates that weekly online reflective journaling provided students participating in a field-based practicum, with an opportunity for self-evaluation and on-going feedback from their supervising instructor. Additionally, a study by Cook-Sather (2005) involving weekly e-mail contact between participants in an undergraduate TEP course, relates that the participants benefited from the consistent communication, space to exchange ideas and reflect on the course expectations and they also reported gaining an understanding of their classmates' lives and experiences through the online contact.

Co-teaching and UDL

An ever- increasing diverse population of students with disabilities receive services in general education classrooms, with co-teaching being the described method of special education service delivery. In one of the first article on co-teaching, Cook and Friend (1995) present five ways that co-teaching can occur in general education classrooms. In it, the authors describe various degrees of teacher-student interactions.

The co-teachers can share the responsibility of teaching the whole class instruction or one co-teacher can teach the majority of the class while the other provides alternative instruction to a smaller group of students. Both co-teachers can present identical instruction to each half of the classroom or students can move between learning stations and receive small group instruction from each co-teacher. And finally, one of the teachers can present the lesson while the other acts as a support. The authors suggest that the co-teaching model of teacher-student interaction should change in response to the needs of the students.

As co-teaching increases in inclusive classrooms, the benefits for students with disabilities continue to be an issue. The research on the advantages of co-teaching for students with disabilities has revealed mixed results. A recent example of this is a meta-analysis on co-teaching research conducted by Murawski, Weichel and Swanson (2001). Using quantitative methodology and effect size as an indicator of success, the authors discovered that only six of 89 co-teaching articles reviewed contained enough information to calculate effect size and when analyzed, the research revealed a range of effects. The highest effects were found in studies that contained dependent measures in language arts, with math measures having moderate effects and social aspects having lower effects. The authors believe that the variability is the result of the limited way in which the articles describe the actions of the co-teachers; yet, also suggest that additional research is needed to determine the effects of co-teaching on student achievement. A study conducted by Weiss (2004) notes the limited availability of research on effects of co-teaching on the skill acquisition of students with disabilities and also attributes this to an inadequate description of research methods. And while a study conducted by

Magiera and Zigmond (2005) agrees that there is inconsistent evidence for the benefits of co-teaching on skill acquisition of students with disabilities, the authors' research revealed that students with disabilities in eleven middle school co-teaching settings received a greater number of one-on-one teacher interactions as compared with similar students in teaching settings that included only a general educator.

While quantitative data on the effect of co-teaching is scarce and provides limited information, recent studies using qualitative research methods provide some insight into the co-teaching environment. For example, a study conducted by Jenkins, Antil, Wayne, and Vadasy (2003) used interview and observation data to examine co-teaching in 21 general education classrooms. The teachers in the study reported positive benefits for their students with disabilities. These benefits included an increase in self-esteem, access to an inclusive learning environment and the opportunity to participate and be successful in classroom activities. Another study by Mastropieri, Scruggs, Graetz, Norland, Gardizie and McDuffie (2005) had similar results concerning students with disabilities and provided examples of differentiated instructional supports for students in the general education classroom. Specifically, in one of the authors' case studies of a high school chemistry class, the co-teachers used peer tutoring and small group activities for lab work, rather than the general educator using whole class instruction with the special educator acting in a assisting role. The authors noted that the differentiated instruction and team-teaching model used by the co-teachers in the study provided the students with disabilities support in the general education classroom and allowed the co-teachers to interact equally with students.

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The Graduate School of Education and Human Development of The George Washington University certifies that Frances Gray Smith has passed the Final Examination for the degree of Doctor of Education as of February 20, 2008. This is the final and approved form of the dissertation.

Perceptions of Universal Design for Learning (UDL) in College Classrooms

Frances Gray Smith

Dissertation Research Committee:

Dr. Pamela J. Leconte, Assistant Research Professor,
Dissertation Chair

Dr. Richard Lanthier, Associate Professor of Human Development,
Committee Member

Dr. Joel Gomez, Associate Professor of Educational Research,
Interim Associate Dean for Research, Committee Member

Dedication

The author wishes to dedicate this entire work to her late father, Clayton Smith, who was so instrumental in her success on this journey. He was her constant cheerleader and encouraged her to pursue such academic pursuits. His natural inclination to always question taught her to seek truth through answers and facts. She owes her writing ability to him, a natural wordsmith, who shared so much through the power of the written word. He offered wonderful commentary and editorial thoughts to some of her emerging writings for this dissertation. Unfortunately, economic circumstances prevented his natural scholarly inquisitiveness to thrive in such an academic climate. Regretfully, the academy did not have the good fortune of learning from his research.

Acknowledgments

In reviewing numerous dissertations, the opening themes often characterize a doctoral journey as much like running a marathon and the importance of sustained motivation, perseverance, and determination. The author concurs with those reflections and adds that, in addition, it takes a focused plan, a crystallized goal, and the support of many—for it truly takes a village to see a doctoral student through the process. As such, the author wishes to acknowledge the many who have offered the important guidance, mentoring, expertise, coaching, and support over the past 4½ years.

She is thankful for the wise counsel of her first two doctoral professors, Dr. Reynolds Ferrante and Dr. Sondra Patrick, who taught her to begin the literature review early and on a topic that could eventually become a research direction. She followed that advice and tried to gather varying perspectives from every course and lecture that could complement this focused discussion of universal design for learning.

She'd like to thank the core group that kept her on track throughout this process. This would never have happened without the support of many. Most importantly, she'd like to thank her doctoral chair and mentor, Dr. Pamela J. Leconte, for her vision to support an emerging idea, offering invaluable commentary to the author's writing, and providing the important and ongoing scaffolds a dissertation chair offers the struggling doctoral student. Her wise counsel, vision, thoughtful suggestions, and tireless support were invaluable. Thank you for this mentoring, this guidance on the side, and this ability to learn and practice through a shared form of "cognitive apprenticeship."

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Abstract of Dissertation

Perceptions of Universal Design for Learning (UDL) in College Classrooms

Universal design for learning (UDL) provides a framework for classroom instruction, which can have substantial impact on students' interests and engagement. UDL is defined by research on diversity, brain-based research, multiple intelligences, and the flexibility digital media brings to the delivery of instruction (CAST, 2006; Rose & Meyer, 2002; Rose, Meyer, & Hitchcock, 2005). The central tenets of a UDL approach, guided by social learning (Bandura, 1986), cognitive learning theories (Bransford, Vye, Stevens, Kuhl, Schwartz, Bell, Meltzoff et al. 2006; Vygotsky, 1978), and research in the neurosciences (Bransford, Brown, & Cocking, 2000; Bransford, Vye, & Bateman, 2002; Goswami, 2004; Rose & Meyer, 2002) have potential to enhance learning for all students, especially in college classrooms. Today's college student brings a plethora of technology skills and expectations that embrace many of the digital tools supportive of a UDL approach.

The purpose of this mixed-methods study was to determine the relationship between use of UDL strategies and level of student interest and engagement in college classrooms at a public university in the Northeast and a private university in the mid-Atlantic region of the United States. Two online surveys were developed to ascertain student and faculty perceptions of UDL approaches and technologies used in classrooms, particularly those that aligned with the three UDL brain networks of recognition, strategic, and affective learning. Surveys also addressed levels of student interest and engagement. Surveys were used to collect data from 182 undergraduate and graduate students and nine faculty members. Responses from 27 student and faculty open-ended interviews were collected in the second phase. Findings from both phases of the study suggest that when faculty members use UDL strategies and technologies in their classes, there is a positive relationship to student interest and engagement. In the interview phase, predominant themes that emerged across three categories of classes (e.g., UDL implementers, some UDL users, and non-UDL users) for both students and faculty included use of (a) online access, (b) discussion groups, (c) ongoing feedback, (d) technology, and (e) multiple instructional approaches.

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Chapter I

Introduction

> "Many creative individuals—including Einstein and the graphic designer M. C. Escher—perform poorly in conventional schools. "In high school in Arnhem," Escher wrote, "I was a particularly poor student in arithmetic and algebra because I had, and still have, great trouble with the abstraction of numbers and letters. Things went a little better in geometry when I was called upon to use my imagination, but I never excelled in this subject while in school." Mathematics nevertheless played a role in his later design of artistic patterns. "Although I lack theoretical knowledge," he observed, "the mathematicians, and in particular the crystallographers, have had considerable influence on my work." Despite his poor performance in school, Escher understood mathematics, though in a way his teachers did not expect or appreciate." (Root-Bernstein & Root-Bernstein, 1999, pp. 21-22)

The evolving importance of digital media (Rosset, 2002; Weigel, 2002), brain-based research (Bransford, Brown, & Cocking, 1999, 2000; Bransford, Vye, & Bateman, 2002; Rose & Meyer, 2002), new learning theories (Bransford, Vye, Stevens, Kuhl, Schwartz, Bell, Meltzoff et al. 2006; Lave & Wenger, 1993; Silverman & Casazza, 2000; Tennant & Pogson, 1995), revised definitions of intelligence (Gardner, 1993,1999, 2003; Sternberg, 1996), and disability legislation (Individuals with Disabilities Education Improvement Act [IDEIA], 2004; National Council on Disability, 2003) have merged to create a new model for education—universal design for learning. Universal design for learning (UDL) provides a framework for classroom instruction that can have substantial impact on a wide range of students to ignite their interests and engage their learning through the applications of technology.

Instructional settings that subscribe to principles and practices of UDL show promise for all learners, especially for learners with special and diverse needs. Research has illustrated the success of this approach and the growing interest in technology strategies when implemented in K-12 classroom settings to support students with disabilities (Dalton, Pisha, Eagleton, Coyne, &, Deysher, 2002; Dolan, Hall, Banerjee, Chun, & Strangman, 2005; Hitchcock, 2001; Hitchcock & Stahl, 2003; Muller & Tschantz, 2003; Rose & Meyer, 2002). The recent inclusion of specific language that addresses the importance of universal design in the reauthorization of the Individuals with Disabilities Education Improvement Act (2004) underscores the importance of UDL (IDEIA, 2004).

UDL is based upon brain research (Bransford, Brown, & Cocking, 1999, 2000; Bransford et al., 2000, 2006; Raz, A. & Buhle, J., 2006; Rose & Meyer, 2002; Rose, Meyer, & Hitchcock, 2005) that verifies individual differences in how people learn. The premise of UDL purports that educators should include an array of instructional strategies and technologies for reaching all students (CAST, 2006; Rose & Meyer, 2000, 2002; Rose et al., 2005). The principles of UDL complement the central tenets of differentiation, focusing instructional strategies and approaches around a student's strengths, motivations, and potential (Tomlinson, 2003).

Recent research on how people learn (Bransford, Brown, & Cocking, 1999, 2000; Bransford et al., 2006) and on the learning brain (Raz, A. & Buhle, J. 2006; Rose, 2001, 2005; Rose & Meyer, 2002; Rose et al., 2005) verifies individual differences in approaches to learning. UDL offers a framework for educators' instruction and assessment based on this brain research and incorporates approaches that highlight flexible opportunities inherent in digital formats. The concept of UDL originates from the Center for Applied Special Technology (CAST) (2006) and builds on the architectural principles of universal design (UD) and learning (CAST, 2006; National Center on Universal Design, 2006; Story, Mueller, & Mace, 1998). To date, most literature and research have studied UDL in kindergarten through 12th grade settings, with exceptions of a few studies conducted in postsecondary settings (Finn, 2005; Scott, McGuire, & Foley, 2003; Scott, McGuire, & Shaw, 2003).

However the postsecondary studies were conducted within a disability context meaning that studies K-12 were based more on the tenets of UDL and those in postsecondary settings were conducted with students with disabilities as the focus. This study aimed to investigate what faculty members and students perceive to be the relationships, if any, of universal design for learning (UDL). The relationship UDL has on students' engagement and interest levels were the impetus for this study.

The digital approaches used by today's students complement the fundamental tenets of UDL and offer a new conceptual model for postsecondary instruction. College students use technology as natural processes in all parts of their lives—in communication, social interactions, and learning (Caruso & Kvavik, 2005; Howe & Strauss, 2003; Oblinger & Oblinger, 2005). Projections estimate that 10.7 million 18-24-year-old students will enroll in colleges by 2012—approximately 61% of the student population (U.S. Department of Education, 2002). Of the recent college population, 72% check e-mail once a day; 85% own a computer; and 73% use the Internet more than the library (Jones & Madden, 2002).

Diverse learners and those with disabilities are enrolling in college in increasing numbers and often rely upon the electronic supports provided through assistive and instructional technologies (National Center on Disability, 2003; Strange & Banning, 2001). Over 49.7 million people are reported as having a disability in the United States (U.S. Census Bureau, 2003). Furthermore, the percentage of college freshmen with a disability has more than tripled in the last 20 years (National Council on Disability, 2003). In 2004, the total college student population was comprised of 30% minority membership (National Center for Education Statistics, 2006) that encompasses students with ethnic and cultural differences. The guiding principles of UDL highlight approaches that address diverse needs of learners. UDL incorporates a wide variety of technology and instructional approaches that can reach all students, regardless of their cultural or language backgrounds, learning styles, needs, or preferences.

Context

Key developments in electronic learning and digital technologies (Jacobs & Dempsey, 2002; Rosset, 2002; Weigel, 2002), improved access to online media tools (Hanna, 1998; Twigg, 2003), and continuing efforts to level the playing field for diverse learners (August & Hatuka, 1997; National Council on Disability, 2003) serve as pivotal forces shaping this new approach to learning founded on the principles of universal design. Researchers are demonstrating the effectiveness of blending these approaches into instructional practices to make more meaningful connections to the instructional material. Jacobs and Dempsey (2002) contend that the influence of distributed learning environments, artificial intelligence, and the expanded research of cognitive and neuroscience will shape the future. These authors note,

> To aid learners in their attempts to construct meaning from information knowledge, instructional designers will rely more and more on emerging

> educational technology. This not so subtle shift toward a learner-centered instructional environment will, in our view, usher in a new instructional systems paradigm that has an increased emphasis on developing new technology-based tools for aiding learning processes. (p. 333)

Universal Design for Learning

UDL, supported by current brain research, has potential to enhance the learner engagement experience. Research in the neurosciences (Bransford et al., 1999, 2000; Bransford et al., 2006; CAST, 2006; Driscoll, 2005; Goswami, 2004; Raz, A. & Buhle, J., 2006; Rose & Meyer, 2002) highlights the value in understanding how the brain receives and assimilates information through multiple hierarchical and parallel processes. Learning viewed through neuroimaging tools such as positron emission tomography (PET) scans and evoked response potentials (ERP) now allow researchers to observe and understand the process of learning—noticing the distinctions between novice and expert learners and the different regions of the brain that are involved in varying learning processes (Bransford et al., 2000, 2002; Bransford et al., 2006; CAST, 2006; Driscoll, 2005; Goswami, 2004; Rose & Meyer, 2002; Rose et al., 2005).

According to CAST (2006), three tenets guide a UDL approach by (a) providing multiple representations of instructional content, (b) allowing multiple opportunities for individuals to demonstrate mastery of content, and (c) creating multiple options for learner engagement. CAST encourages a shift from reliance upon a single, printed text medium to one that is digital—increasing its transformable and malleable qualities (CAST, 2006; Rose & Meyer, 2002; Rose et al., 2005). For example, instructional materials that are in digital formats can be easily enlarged, color-coded or restyled, read aloud by a speech synthesizer, and hyperlinked to supporting materials.

The importance digital media bring to an instructional situation is central to the recently adopted National Instructional Materials Accessibility Standard (NIMAS), which offer national guidelines for K-12 electronic book publication for universal file formats (NIMAS, 2006; U.S. Department of Education, 2006). This standard provides a more universally accessible medium for instructional materials and addresses the needs of many K-12 students who have disabilities and use assistive technologies (NIMAS, 2006; U.S. Department of Education, 2006). When NIMAS standards are considered, publishers and others provide digital formats that are usable across an array of assistive and technological devices (NIMAS, 2006; U.S. Department of Education, 2006). Achieving an accessible digital format is a central conversation of the National Association of Higher Education and Disability (AHEAD, 2006). The work of such projects as the Daisy Consortium (2006) supports the international attention to developing a universal digital format that can be accessed by all individuals with print disabilities. Digital formats, accessible files and assistive technologies make learning easier for all students.

Engaging Today's College Students

Today, opportunities to engage students' learning through technology are growing. In the college environment, student engagement is an important focus for college administrators as they seek to maximize students' experiences on campus and understand how colleges provide for these opportunities (Center for Postsecondary Research, 2004; Kuh, 2003). The use of technology in higher education is increasing as members of the millennial and digital generations enter college (Howe & Strauss, 2003;

Oblinger & Oblinger, 2005)—bringing new digital approaches and expectations for the classroom instructor (Caruso & Kvavik, 2005; Levin & Arafeh, 2002; Prensky, 2001, 2005). Oblinger and Oblinger note that among these "net generation" students, 20% began using computers between the ages of five and eight. These students are developing greater digital literacy and are more comfortable in Web-based environments that focus on expression through audio, video and graphics (Oblinger & Oblinger, 2005). The inclusion of technology approaches is essential to engage today's college students.

Infusing digital media into classroom instruction supported through UDL capitalizes on ways to customize students' learning experiences while maximizing their success (Bransford et al., 1999, 2000; Bransford et al., 2006; Bransford, Vye, & Bateman, 2002; Brown, 2000). Strategies that complement a UDL approach and enhance student interest and engagement are noted in research on background knowledge (Strangman & Hall, 2004), highlighting critical features (Strangman & Hall, 2003), using graphical organizers (Strangman, Hall, & Meyer, 2003), and enabling electronic text transformations (Hasselbring, Lott, & Zydney, (n.d.); Silver-Pacuilla, Ruedel, & Mistrett, 2004; Strangman & Hall, 2003). Background or prior knowledge includes the skills, beliefs, and concepts that individuals bring to a new learning situation (Bransford et al., 2000). Research has illustrated the success of UDL and the growing interest in these strategies when included in K-12 classroom settings (Dalton et al., 2002; Dolan et al., 2005; Muller & Tschantz, 2003; Rose & Meyer, 2002) and to support students with disabilities when applied to large-scale assessments (Johnstone, 2003; Thompson, Johnstone, & Thurlow, 2002; Thompson, Johnstone, Anderson, & Miller, 2005). A

Study of the Impact of Universal Design for Learning in the Elementary Classroom

Dissertation

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by

ANNE F. THORP

Prescott, Arizona
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APPROVAL

Study of the Impact of Universal Design for Learning in the Elementary Classroom

by

Anne F. Thorp

Approved by:

Dr. Shad Bailey Ph.D ____________________ 11/13/08 ____________________
Chair: *Dr. Shad Bailey, Ph.D.* Date

Member: *Dr. Tony Pellegrini, Ed.D.*

Member: *Dr. Troy Robinson, Ed.D.*

Certified by:

Dr Angie Parker ____________________ 11/18/08 ____________________
School Dean: *Angie Parker, Ph.D.* Date

ABSTRACT

Study of the Impact of Universal Design for Learning in the Elementary Classroom

by

Anne F. Thorp

Northcentral University

September, 2008

Today's diverse classrooms include students of all academic levels, needs, learning styles, languages, and abilities. With the implementation of No Child Left Behind (2001), students with diverse learning needs, such as special education students with an Individual Education Plan, or second language learners, are required to learn the same information as the general education curriculum for the purposes of testing. No Child Left Behind reports indicate that at least one quarter of United States schools are struggling to achieve Annual Yearly Progress (AYP). Furthermore, now that the Higher Education Opportunity Act (HEOA) (Public Law 110-315) enacted August 14, 2008 contains provisions for Universal Design for Learning (UDL), research to show its benefit to teacher preparation and student learning may guide educators of all levels in the implementation of UDL to meet the needs of learners of all ages. Through the application of Universal Design for Learning (UDL) principles, higher levels of success may take place in classrooms in spite of the diverse needs of students leading schools to achieve AYP. In order to determine the benefits and best practices or processes of Universal Design for Learning implementation, a sound research design must be implemented. The key question researched here is whether or not the implementation of UDL principles impacted fourth grade students' reading grades. A one tailed *t*-test analysis was conducted for this study, comparing grades prior to and after the implementation of UDL into the classroom. This study used a combination of qualitative and quantitative data gathered during research. Report card reading grades determined the quantitative outcomes, and then teacher and student follow-up surveys comprised the qualitative data. The purpose of this research is to determine whether student learning is greater than, equal to, or less than in one setting over the other. This study examined student-learning data prior to the implementation of the principles of UDL and the impact of the implementation on student achievement, participation, and interactivity. Research outcomes indicate that the implementation of UDL into the elementary classroom has a positive impact on student learning in a variety of ways.

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This work is dedicated to learners of all ages everywhere.

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CHAPTER 1: INTRODUCTION

Introduction

Today's classrooms include students of all academic levels, needs, learning styles, languages, and abilities. With the implementation of No Child Left Behind (2001), students with diverse learning needs such as special education students with an Individual Education Plan, or second language learners, are required to learn through the general education curriculum for the purposes of testing. Additionally, classrooms are filled with learners of different styles, needs, and background knowledge. Meeting the needs of students with different learning styles is a significant element in the teaching and reaching of diverse learners. Through the application of Universal Design for Learning principles, higher levels of success may take place in classrooms in spite of the diverse needs of students regardless of the types of differences these students bring to the classroom.

Statement of the Problem

Because NCLB reports indicate schools are struggling to meet Adequate Yearly Progress (AYP) programs to increase student achievement are quickly being developed. Since NCLB mandates all students learn through the general education curriculum, educators and students would benefit from curriculum adjustments in order to increase achievement for all in today's classrooms of diverse learners. Universal Design for Learning (UDL) principles implemented into the classroom curriculum may be the answer to teachers' and principals' wishes for increased AYP scores. In February 2007, the UDL Taskforce sponsored a congressional briefing that included UDL. The outcome of that briefing concluded with the signing of Higher Education Opportunity Act (HEOA) into law on August 14, 2008 by President George W. Bush. This HEOA includes UDL in the practices of teacher preparation, school report cards, meeting the needs of varied learners in higher education, and using technology to prepare teachers to meet the needs of digital learners (National Design for Learning Taskforce, 2008). The addition of UDL to the HOEA brings the awareness of its strengths and the possibilities of increased learning to the forefront in teacher preparation and meeting the needs of all students. Additionally, new teachers coming into the field will be well prepared to meet the needs of the diverse population they will face in their classrooms. Studying the benefits of UDL in the classroom may bring further awareness of its power as well as indicate the increase in student learning that its adoption conveys.

Studies such as this one may bring awareness to the variety of technologies, processes, and learning issues that the implementation of UDL may employ. Additionally, studies of the integration of UDL principles may lead to further understanding and implementation of the principles and processes of UDL for the betterment of teaching and learning.

Background and Significance of the Problem

Today's classrooms are composed of students of all academic levels, needs, learning styles, and abilities. With the implementation of NCLB (United States Department of Education, 2002) students with diverse learning needs such as special education students with an Individual Education Plan (IEP) or second language learners are required to learn materials commensurate with the general education curriculum. To illustrate how this mandate, achieving AYP, has proved to be a daunting task for teachers and students, Jennings (2004) reported that in 2003 about 32% of the schools evaluated did not meet the AYP for at least that year and about 7% did not meet AYP for two years. According to the National Education Association (2008), the percentage of schools not making AYP in the 2007-08 School Year is 28.1 and the percentage of schools in Improvement/Corrective Action is 13%.

One possible solution to moving more schools toward the achievement of AYP is Universal Design for Learning. UDL is an instructional approach incorporating technology in order to guide students with varied learning needs to reach success in their learning environment.

The Kentucky Department of Education describes UDL

> Delivering curriculum and implementing instruction through the lens of Universal Design means considering the needs of a wide range of learners, including strengths, weaknesses, and learning styles. Instead of retrofitting a pre-designed curriculum, teachers design and plan instruction to meet a wide variety of needs of their students, and considering individual differences. (2007 ¶ 1)

UDL is not another product teachers need to implement into their classrooms, but is a framework that taps into recent brain research that indicates that all brains learn differently (CAST, 2007). UDL offers applications to provide access to the general education curriculum in order to meet the needs of all students, regardless of learning style. UDL offers a structure for specialized goals and gathering curriculum resources with various media, stages of challenge, and learning scaffolds, allowing all students to learn through the general education curriculum. According to The Center for Applied Special Technology (CAST), "This is accomplished by simultaneously providing rich supports for learning and reducing barriers to the curriculum, while maintaining high achievement standards for all students" (2007, ¶ 1). Additionally, CAST pointed out that "Universal Design for Learning is a framework that enables educators to develop curricula that truly 'leave no child behind' by maintaining high expectations for all students while effectively meeting diverse learning needs" (2007, ¶ 5).

With the flexibility of digital access and media available today, learners are provided greater opportunities for learning through individual means. UDL principles are based on recent brain research showing that there are three primary networks in the brain: (a) The recognition network is how the brain gathers facts and identifies the "what" of learning; (b) The strategic network is the planning network of the brain and is significant in identifying the "how" of learning; and (c) The third network is the affective network, which is the network of engagement and motivation and is a key identifier in the "why" of learning.

Application of these principles is accomplished through multiple and flexible means of representation, expression, and options for engagement. The word "Universal" in UDL does not mean that there is a single answer for every learning need. It is "meant to underscore the need for multiple approaches to meet the needs of diverse learners" (CAST, 2007, ¶ 4). Burgstahler (2002), CAST (2006), and the Council for Exceptional Children (CEC) (2005) indicated that studies are just beginning to emerge on the effects of UDL principles implemented into the classroom curriculum. Through the application of UDL principles, higher levels of success may take place.

Forty-five of the 50 states are addressing the emerging practice of Universal Design according to the National Center on Educational Outcomes in a document titled *2005 State Special Education Outcomes: Steps Forward in a Decade of Change* (Altman, Johnstone, Thompson, & Thurlow, 2005). Iowa, New Jersey, Minnesota, South Dakota, and Washington were not addressing Universal Design at the time of publication (Altman, Johnstone, Thompson, & Thurlow, 2005).

Kentucky's program regulations require that instructional materials and technologies to be considered for state adoption "must be made available by publishers in accessible digital format" (Kentucky Department of Education, 2008, ¶ 3). Teachers across Kentucky are participating in the professional development programs offered for the successful implementation of UDL into their classrooms. Additionally, the Kentucky Accessible Materials Database (KAMD) provides an opportunity for state schools to locate materials that are available digitally.

Hebert and Williams (2006) asserted

> The mission of the Louisiana Universal Design for Learning (UDL) initiative is to design and implement a model for teaching and learning that will meet the needs of all learners through the use of best practices, adaptive technologies, and instructional techniques to accommodate all teaching and learning styles. (¶ 1)

Louisiana provides opportunities for their teachers to learn UDL principle implementation through their program called Bridging the Gap through UDL. The Louisiana Department of Education described this program as "Bridging the Gap through Universal Design for Learning. (UDL) is a DOE cross-division initiative for educators who are committed to improving educational outcomes for all learners" (2007, ¶ 1).

Michigan's Local Education Agencies are also participating in UDL's growth. Agencies across Michigan are participating in The Rescue (Reading E-text SCanned for Universal Education) Project that

> Intends to provide alternative format, specifically electronic text, of printed curriculum materials (textbooks, novels, and so forth) to students with disabilities. By providing curriculum materials in electronic format to school districts, students with disabilities can utilize various technologies to assist them with reading. In this way, all students will be able to access their school's curriculum to acquire knowledge. (Ingham ISD, 2008 ¶ 1)

The Rescue Project maintains a book directory to help teachers learn which books are available to their students. Additionally, the Michigan Integrated Technology Supports (MITS) "provides informational services, support materials, and professional learning opportunities to improve outcomes for all students" (MITS, 2007, ¶ 1). MITS is "a Mandated Activities Project of the Michigan Department of Education, Office of Special Education and Early Intervention Services" (MITS, 2007, ¶ 1). Furthermore, Michigan's Regional Educational Media Centers (REMC) provides many supports for teachers in order to bring UDL into their classrooms. For example, the REMC Association of Michigan (REMCAM) provides subscriptions to Discovery Education *streaming* for every member. In addition, REMCAM provides access to digital materials and a statewide School Aggregated Volume Buy Catalog for Education programs where schools can locate a variety of educational resources at discounted prices.

The purpose of this study was to determine the impact of UDL implementation on student achievement in classrooms of diverse learners through the addition of technology implementation. Technologies used in this study included the use of Discovery Education *streaming*, Inspiration®, the Microsoft built in accessibility supports on school and classroom computers, and the Classroom Performance System (CPS).

Discovery Education *streaming* "is a digital video-on-demand and online teaching service" (Discovery, 2008, ¶ 1). Discovery Education *streaming* contains over 7,700 videos, many with closed captioning options, and Spanish titles from over 100 educational publishers. Additionally, Discovery Education *streaming* contains audio files, editable clips, and over 23,000 images along with customizable options for creating assignments and quizzes to differentiate learning. School resources and an educator network are part of Discovery Education's Discovery Education *streaming* package. While Discovery Education *streaming* was used for this study, there are websites available where videos are obtainable for teacher use at no cost. The significance of these sites is for teachers or districts who do not subscribe to Discovery

Education *streaming* so they may also benefit from these resources. Websites such as The Research Channel (http://www.researchchannel.org/prog/), Annenberg Teacher Resources, (http://www.learner.org/resources/browse.html), and National Geographic (http://video.nationalgeographic.com/video/) provide digital videos online that can be used in the classroom.

Inspiration® is a mind mapping software that allows teachers and students to research and plan projects through graphically organizing their thoughts and ideas, which can then be transformed into an outline with the click of a button. Inspiration® is described as "The essential tool to visualize, think, organize, and learn" (Inspiration®, 2008, ¶ 1). I Inspiration® can be purchased by individual license or by volume for labs or schools. Volume license costs are dealt with through the company based on the number of licenses needed. An alternative to I Inspiration® is a product called FreeMind, a program to download directly from the Internet at no cost. FreeMind is very much like Inspiration® in its look, functionality, and goals, all without the cost. FreeMind can be found at http://freemind.sourceforge.net/wiki/index.php/Main_Page.

The Classroom Performance System (CPS) is an interactive software program on the computer that the teacher can set up as a game, quiz, test, or team activity. The computer is then connected to a projector and students participate in the activity by handheld remote keypads. As students respond, the software program keeps track of responses and gives instant feedback to the teacher and students. The cost of the CPS varies by the number of responders purchased, and the type of responder, (e.g. infrared or radio frequency). CPS information can be found at http://www.einstruction.com/.

Microsoft built in accessibility supports on school and classroom computers were made available for students to set to meet their learning needs. The Microsoft accessibility options allow users to configure and personalize computer functions to best fit their vision, hearing, and mobility needs. Students were taught these functions after which they personalized their district account to meet their learning and computer needs.

The goal of this study was to evaluate the use of UDL through technology in two fourth grade classrooms. The findings of this study might lead to an understanding of UDL principles and their relationship to curriculum development through technology intervention. It is expected to result in higher achievement for students in the classroom. The findings of this study may shed light on improvements in delivery and teaching established through the implementation of UDL principles. Additionally, it may bring an awareness of approaches in the diverse classroom through the implementation of simple technology strategies.

Research Questions

In order to complete a comparative analysis of student learning in classrooms before and after UDL principles are implemented, significant questions must be answered such as, "Does the implementation of UDL principles increase student achievement?" Based on the researcher's experience and the research of Casper and Leuchovius (2005) and Meyer and Rose (2002), results might show student achievement is increased because of the implementation of UDL principles. Due to students' learning through a flexible curriculum and using materials that are not 'one size fits all' but are adapted to meet learning needs of individual students, increased participation, motivation, and learning might take place. A subset of research questions for this study included:

1. How does student achievement prior to UDL implementation compare to achievement after UDL implementation?

2. Is student achievement in UDL classrooms equal to or above achievement prior to UDL implementation?

3. Does individual student participation increase in UDL classrooms as compared to participation prior to implementation of UDL principles into the classroom?

4. Do students in UDL classrooms incorporating technology tools engage interactively as frequently as prior to UDL implementation?

These questions guided this research study in determining the benefits of UDL implementation into curriculum, teaching strategies, and classroom processes.

Definition of Terms

Adequate Yearly Progress (AYP). A measure of a school's or school system's ability to meet required federal benchmarks with specific performance standards from year to year (Knox, 2004).

General Curriculum. The same curriculum as that provided to students without disabilities (Karger, 2004).

No Child Left Behind (NCLB). It was implemented during the 2002-2003 school year. It requires schools to have 100% proficiency among students in math, reading and language arts by 2014. They must also meet graduation and attendance standards (Knox, 2004).

Universal Design for Learning (UDL). A framework for designing curricula that enables all individuals to gain knowledge, skills, and enthusiasm for learning. UDL provides rich supports for learning and reduces barriers to the curriculum while maintaining high achievement standards for all (CAST).

Highlights and Limitations of Methodology

The elementary classroom was chosen as the location for the undertaking of this study of UDL technology integration. Studies located thus far have been based on middle school case studies of UDL processes and implementations (CAST) or surveys based on opinion of the integration of technologies in the classroom in a high school setting (McClannon, 2006). A study of the impact of UDL on grades and student achievement had not been previously completed or located. Previous studies of this type have not been found; therefore, this study is not a replication of any preceding studies or study. New research is a necessity to further understand the impact of UDL implementation in diverse classrooms. In order to advocate the implementation of UDL into new and existing curriculum, it is essential that research studies show success through increased student achievement. The purpose of this study is to determine the impact of UDL, through technology implementation, on student achievement in classrooms of diverse learners.

The goal of this study is to complete an evaluation of UDL implementation in two fourth grade classrooms. Fourth grade is the chosen grade level since this grade level has had four years of education and intervention, as well as the idea that maturation has leveled off so as not to interfere with study results. Younger grade levels may still have growth in maturity, which may create a challenge in determining if maturation or UDL strategies affected the outcome of the study and impacted student learning and success. Implementing a new method of teaching and learning in any age group may demonstrate clearly the success of UDL principles. However, for the purpose of the study fourth grade has been selected.

While the results of this study may be revised to meet any grade level, this project may lead to an understanding of UDL principles and their relationship to technology use and curriculum development. The implementation of UDL principles in this study are expected to result in higher achievement for students in participating classrooms.

For the purposes of this study, the ultimate goal of UDL as described by the Council for Exceptional Children is to, "appropriately challenge and effectively engage the full range of students: those with disabilities and those without, those who are average, as well as those who are below and above average" (2006, p. xii). Once an understanding of UDL principles and teaching methods is realized, improvements in delivery and teaching approaches can be created in order to continuously increase student learning and create best practices for teaching delivery in the diverse classroom. Additionally, professional development for teachers desiring to implement UDL principles may be impacted by the results of the study, in that a positive correlation may lead teachers to understand clearly the benefits of such an implementation into teaching strategies. Furthermore, higher education implementing UDL into teacher preparation may benefit from studies of the impact UDL principles have on learning and student success.

This study is designed to assess the impact UDL implementation has on the classroom with additional technology use taking place on a regular basis. While both internal and external validity are significant factors in any research project, in this case external validity is crucial as results may be generalized and applied to other situations, groups, and populations to further understand the benefit of UDL implementation into classroom curricula. Additionally, study results may be duplicated for further study and implementation. Internal validity will be more of a challenge to maintain, as there will be variables over which the researcher has little or no control. These variables include parental support of the study, daily classroom schedules, as well as student and teacher attitude toward the implementation process of the UDL principles and technologies. These factors may create validity and reliability issues that the researcher has not only no control over, but also in the level of consistency with the testing instrument with this particular group of participants.

This study reviewed reading grades given by current classrooms teacher at the end of the report card marking period and compared them to grades earned in the final marking period. Teachers used their usual teaching strategies in the classroom until the end of the second grading period when they began the implementation of the newly learned UDL strategies into the classroom. This method allowed teachers to observe students in the general education classroom as well as assess student-learning styles while learning the technologies and UDL strategies that will be implemented into the classroom. Using report card grades before and after UDL implementation may guide classroom teachers to determine which strategies are successful in reaching learners. Additionally, the report card differential may lead the researcher to more closely determine strategies that indicate more success than others.

The Michigan Educational Assessment Program (MEAP) test is administered early in the school year. This assessment is given too early in the school year to be used to determine results based on any implementation of UDL principles in the classroom; therefore, those scores will not be factored into this study. The MEAP is given in early October and scores are not reported until the next calendar year. Using the MEAP results as a measure of UDL impact would not be an effective measure since there would not be enough time in the school year to implement principles to affect MEAP scores. Additionally, if MEAP scores were considered, the test scores that would be reviewed would have been from another year, another teacher, possibly even another school, therefore making those scores not in accordance with this study's goals.

Comparing reading grades before and after UDL implementation may bring significant information on how this process might assist raising scores to increase success and achieve AYP.

Even thought this study focuses on report card grades, the standards being taught in the classroom are the same standards, benchmarks, and grade level content expectations measured on the MEAP.

Maturation is another consideration as a threat to internal validity. Anytime children are involved in a study, there is the possibility of this threat since the children are growing, learning, and applying their learning throughout the term of the study. According to RAVID,

> Maturation is a particular threat to internal validity in studies that last for a longer period of time (as opposed to short-duration studies), or in studies that involve young children who experience rapid changes in their development within a short period of time. For example, suppose researchers want to enhance fine motor coordination of preschoolers by providing special time each week for them to practice tying their shoes. Before and after a six-month program, the children's coordination is tested. A significant improvement in the children skills in tying their shoes may be due to the intervention (practice time). However, it is also possible that the children are better able to perform certain tasks that require fine motor coordination simply because they are older. (2005, p. 7)

While this will not be a long-term study, the threat of maturation may be present if the study subjects are a group of younger students such as second or third graders early in the school year who are still learning classroom practices, to read fluently, and to follow directions intrinsically. Even the course of six weeks at these ages may indicate maturation in the classroom. In the case of a group of older students, such as fourth or fifth graders, maturation from the beginning may not pose as large a threat as their rate of growth has leveled. To avoid the threat of maturation validity, this research focuses on a group of older students with

ADMINISTRATIVE ATTITUDES AND FACTORS FOUND IN SPECIAL EDUCATION DIRECTORS IMPLEMENTING UNIVERSAL DESIGN FOR LEARNING/E-TEXT WITHIN A STATE SPECIAL EDUCATION SYSTEM

By

Michael M. Abell
B.A., University of Louisville, 1989
M.S., University of Kentucky, 1991
Ed. S., University of Kentucky, 1992

A Dissertation Approved on

March 2, 2006

by the following Dissertation Committee:

Thomas J. Simmons
Dissertation Director

Joseph Petrosko

William M Parrot

Bernard Strenecky

Jim ? Garcia

DEDICATION

This dissertation is dedicated to my Lord, Jesus Christ, who gave me the courage to walk this difficult path and the wisdom to reach its end. May all of those who read this find the same blessings on your journey as I have.

ACKNOWLEDGMENTS

I would like to express my deep love and appreciation to my dear wife, Karen, for her understanding, encouragement, and patience, and to my sons, Drew and Clay, for their understanding and support. I hope my sons see that even goals that seem insurmountable can be accomplished by those who trust in Him. I would also like to thank my parents, Jim and Mary Jo Abell, and my sister, Marianne, for a loving and supportive family while growing up and instilling the values of faith, family, education, and hard work.

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ABSTRACT

Administrative Attitudes and Factors Found in Special Education Directors Implementing Universal Design for Learning/E-text within a State Special Education System

Michael M. Abell

March 2, 2006

This study examines the attitudes and factors valued by Kentucky directors of special education (DOSE) currently implementing universal design for learning (UDL) principles within their school districts. UDL principles call for curriculum flexibility in relation to content presentation, student expression, and student engagement (Rose & Meyer, 2002c). UDL is a new approach for teaching, learning, and assessment, that draws on brain research and new media technologies to respond to individual learner differences (Center for Applied Special Technology, 2002).

The purpose of the study was to provide new information to DOSEs by researching leadership issues and aspects involving district level UDL implementation. Department level professional development and technology implementation issues were also explored. Attention was given to early adopters and variables relating to full implementation within a systems change initiative.

The survey instrument was adapted from the Managerial Practices Survey (Yukl and Lepsinger, 1990) to measure managerial behaviors. The survey was sent to the 176 directors of special education in the state of Kentucky. Eighty nine surveys were

returned with usable data for a 50 percent return rate. The district selection criteria was based on participation in the 2004 CATS Online assessment which 36 districts of the 176 in Kentucky participated in. The state criteria (Kentucky Department of Education, 2005) for participation in the CATS Online assessment required each district's administrative leadership to receive training on UDL principles, installation of UDL relevant software, and professional development on how to use the CATS Online assessment in accessible format.

The data are broken into two separate sets for the purpose of this study. The first data set (data set I) consists of all respondents (*n*=89) and is used for descriptive purposes and to report general opinions of DOSEs. Data set II is comprised of respondents (<u>n</u>-19) from 36 DOSEs identified as knowledgeable and implementing UDL principles for a response rate of fifty three percent. Data set II is used for all statistical analyses encompassing *t*-tests, analysis of variance, and multiple regression methods.

The results are important to the field of special education now that IDEIA (2004) includes policy language that encompasses UDL. This study found no significant differences in DOSE's gender, education level, or years of administrative experience as relates to the DOSEs own level of educational innovation. The Cost Factors of UDL Implementation is significant regarding district acquisition of curriculum in digital formats and the technology infrastructure to run it, but was not a significant predictor. Finally, there is no significant relationship between DOSE core knowledge of UDL/E-text in relation to the size of their district special education population.

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Chapter One

INTRODUCTION

The purpose of this study was to examine the attitudes and factors valued by Directors of Special Education (DOSE) implementing a Universal Design for Learning (UDL) initiative within special education programs across Kentucky. Particular attention was given to leadership abilities valued by DOSEs involved in the implementation of digital content (E-text) within their special education programs. The UDL/E-text initiative was implemented by the Kentucky Department of Education to increase students' access to the general curriculum and increase overall academic achievement. Thus, it is important to examine implementation factors and attitudes of those directly responsible for its implementation at the district level. UDL is grounded in the work of Lev Vygotsky (1978) and the zone of proximal development (ZPD), the range at which learning takes place (Fisher, Berliner, Fully, Marliave, Cahen, & Dishaw, 1980) which serves as a foundation for UDL in its effort to improve student learning through access to flexible digital curriculum (E-text). The digital curriculum can then be modified or altered to meet the unique cognitive style of each learner. This study analyzed the leadership qualities valued by DOSEs implementing UDL and its accompanying component of E-text using a descriptive and correlational research design. Particular attention was given to qualities identified by DOSE as valuable to their implementation efforts in relation to non-significant qualities. These factors focus on leadership issues involving gender, education level, years of administrative experience, and aspects involving district-level implementation such as cost factors and size of the districts special education population. Department-level professional development and technology implementation issues were also explored as were qualities affecting early adopters. The variables relating to full implementation within school districts in the context of a systems change initiative were also analyzed. The following research variables were examined in this study: (a) Leadership Commitment to Change; (b) Core Knowledge of UDL Principles; (c) Educational Innovation; (d) Curriculum in Digital Formats; (e) Technology Infrastructure; (f) Cost Factors of UDL Implementation; (g) Assessment and Accountability; (h) Teacher Professional Development; (i) Years of Administrative Experience; (j) Education Level; (k) Gender; and (l) Number of Special Education Students in District.

Statement of Problem

In the United States, an increased emphasis on school accountability in conjunction with high stakes testing has led many states to examine new approaches to improve student achievement (Potter, Reynolds, & Chapman, 2002). The rapid growth of technology, along with new learning approaches and improved access to digital content, offers students new possibilities for learning and increased academic success.

Significant efforts have been made across Kentucky to increase student achievement. In particular, goals have been set by the Kentucky Department of Education to raise all student test scores to the proficient level by 2014 (Kentucky Board of Education, 2001) which correspond to the No Child Left Behind (2001) federal mandate for student achievement. Proficiency is the goal the Kentucky Board of Education has set for every school to reach by 2014. It is based on a school accountability index score of 100 out of a possible 140 points. Diverse learners in special education programs across the state will face even greater difficulties as a result of their disabilities. In order to provide enhanced learning experiences for special education students, (e.g.,those identified by school districts as having a disability) to reach proficiency, Kentucky has instituted a program based on Universal Design for Learning (UDL). UDL and its use of technology (e.g., E-text, computers) offer a host of benefits to students with diverse learning styles (e.g., auditory, visual, tactile learners). UDL and its accompanying software tools and E-text enables instructional content to be adapted to meet a variety of learning styles using technology: for example, altering the size, color, and background color of the text to improve student attention. The program also enables speech quality, speed, pitch, and words spoken per minute to be manually adjusted or altered by the student or teacher. UDL based accessible E-text may be presented in different digital formats on such devices as Personal Digital Assistants (PDA), laptop computers, or portable audio players.

This dissertation examined the leadership attitudes and factors valued by Directors of Special Education (DOSE) implementing the UDL initiative in special education programs across Kentucky. Particular attention was given to: (a) Leadership Commitment to Change; (b) Core Knowledge of UDL Principles; (c) Educational Innovation; (d) Curriculum in Digital Formats; (e) Technology Infrastructure; (f) Cost Factors of UDL Implementation; (g) Assessment and Accountability; (h) Teacher Professional Development; (i) Years of Administrative Experience; (j) Education Level; (k) Gender; and (l) Number of Special Education Students in District valued by DOSEs involved in implementing digital content (e.g., E-text) in special education programs. This study investigated how these leadership attitudes and factors (Maurer, 2004; Goldring & Sims, 2005; Mosenthal, Lipson, Torncello, Russ, & Mekkelsen, 2004; Sun, 2004) related to UDL leadership issues and district level implementation. Department level professional development and technology implementation issues were also explored in this study. In addition, this study sought to uncover the leadership qualities that influenced early adopters and thus the full implementation of the UDL program. Dockery and Gushee (1999) define early adopters as leaders who envision new programs, delivery systems, and take advantage of new opportunities that become available. West and Farr (1990) offer a definition of innovation as it relates to leadership and early adoption:

> The intentional introduction and application within a role, group or organization of ideas, processes, products or procedures, new to the relevant unit adoption, designed to significantly benefit the individual, the group, organization or wider society. (p.9)

Background

Since the formal inception of public school programs serving students with disabilities in 1976 (P.L 94-142), educators have researched new and innovative ways to increase achievement such as differentiated instruction (Datnow & Castellano, 2001; Ellis, & Fouts, 1997; Harris, 2000; Tubin & Chen, 2002; Tomlinson, & Doubet, 2005). Tomlinson (2000) defines differentiation as a way of viewing teaching and learning that is based on a belief that students who are the same age differ in their readiness to learn, their interests, their styles of learning, their experiences, and their life circumstances.

Specific school-based programs have also evolved to serve students with disabilities based on their identified need. These programs have varied from self-contained direct instruction programs to resource and full inclusion programs. A self-contained classroom placement is used when a student with a disability is not able to receive meaningful instruction in the general education classroom or resource classroom. In this case the IEP committee may decide to place the student in a special education classroom for more than one half of the student's academic instruction. A resource classroom may have students who require more instruction from the special education teacher for some skill areas. After careful consideration that instruction in the general education classroom with defined supports may not meet the education needs of the student, the IEP committee may decide that the resource classroom is the appropriate placement for part of the student's academic instruction. Finally, full inclusion programs offer students with disabilities the opportunity to receive special education services in the general education classroom with their appropriate, non-disabled peers. The IEP committee must consider the curriculum and the need for additional supports (e.g., instructional modifications, accommodations for learning styles, technology support, etc.) before such a placement is made.

States have implemented efforts to improve student learning in ways that begin to connect students' individual learning styles with the core content taught in schools. The general curriculum is the central guide by which all students are educated within the United States according to Bremer, Clapper, Hitchcock, Hall, and Kachgal (2002). The general curriculum has traditionally been presented in a text-based print format. This format began with the invention of the Gutenberg printing press and followed by the binding process which resulted in durable hardcover books (Eisenstein, 1979). Textbooks continue to be the major format in which educational curriculum is delivered to students in public schools.

Special education programs in the United States were developed to meet the individual needs of students identified with a disability. A disability is defined as "a physical or mental impairment that substantially limits one or more of the major life activities of such individual" (Colbridge, p.28). The system was built upon a classification system based on disability categories. Instructional material used with students centered on print-based textbooks, curriculum materials, and adapted or altered materials created by teachers. These materials were created to increase individual student understanding. The materials also provided a conceptual bridge to link individual learning styles and preferences exhibited by those students with the instructional content. Hartley (1998) defines learning styles as the ways in which individuals characteristically approach different learning tasks. Matching instruction with individual learning styles through flexible representations of content provides students opportunities to demonstrate mastery.

Universal Design for Learning is a conceptual framework (Dolan & Hall, 2001; Meyer & Rose, 1998; Pisha & Coyne, 2001; Rose, 2001; Rose & Dolan, 2000; Rose & Meyer, 2000a, 2000b, 2002; Rose, Sethuraman, & Meo, 2000) that guides the design of curricula that are flexible and supportive of all students' unique approach to the learning task (Hartley, 1998). UDL advocates for the design of curricula that meets the learning needs of all students so that methods, materials, and assessment are usable by all. This means in practice that students using these materials can control the layout and presentation of the instructional material that best suits their approach to the learning task (Hartley, 1998). Some students might select an online assessment with more graphics for visual cues while others might use the audio feature to have questions read to them. The concept of UDL is inspired by the universal design initiative in architecture. This initiative calls for the design of structures that anticipate the needs of individuals with disabilities and accommodate these needs from the outset. Universally designed structures are then usable by individuals with disabilities and offer unforeseen benefits for all users. Just like in architecture, assessable curricula can benefit students of varying ability levels too.

UDL emphasizes the importance of providing appropriate instruction targeting individual student needs. Hitchcock, Meyer, Rose, and Jackson (2002) operationalize a UDL curriculum into four categories: (1) goals, which provide appropriate challenges for all students, (2) materials that have a flexible format supporting transformation between media and multiple representation of content to support all students, (3) methods, which are flexible and diverse enough to provide appropriate learning experiences, challenges, and supports for all students, and (4) flexible assessments to provide accurate, ongoing information that helps teachers adjust instruction and maximize learning. Burgstahler (2002) advocates for the equitable and flexible qualities that are found in universally designed curricula. The Council for Exceptional Children (1998) defined Universal Design for Learning as:

> In terms of learning, universal design means the design of instructional materials and activities that make the learning goals achievable by individuals with wide differences in their abilities to see, hear, speak,

move, read, write, understand English, attend, organize, engage, and remember. Universal design for learning is achieved by means of flexible curricular materials and activities that provide alternatives for students with differing abilities. These alternatives are built into the instructional design and operating systems or educational materials-they are not added on after the fact. (p.2)

UDL does not rely solely on flexible curriculum materials for its conceptual framework. The human brain plays a critical role in how a person responds to the curriculum materials presented in a learning activity. UDL anchors itself in cognitive neuropsychology and the relationship between higher mental functions and the human brain structure from an information-processing perspective (Roland & Zilles, 1998; Rose & Meyer, 2002c). Rose and Meyer (2002c) describe the human brain through three neurological networks (Recognition, Strategic, and Affective) which moderate how we understand, process, and emotionally connect with learning. Hitchcock, Meyer, Rose, and Jackson (2002) present a proposition that current instructional curriculum in print format is not designed to promote curriculum access for all students. In fact, the print-based medium of textbooks is outdated and limited in its flexibility. Printed content cannot be accessed electronically because textbooks are static which restrict their flexible utilization over a computer network unless converted to digital format. Having content in digital format provides both teachers and students the opportunity to easily adjust and change the way content is represented. UDL offers the opportunity to alter curriculum content electronically to meet each student's individual needs (Behrmann, 2001; Rose and Meyer,2002c). UDL is one such method that meets individual student learning needs by bringing to bear the power of the general curriculum utilized by all students and teachers and presents it in a wide variety of formats through the use of computer technology (Hitchcock et al., 2002).

The academic challenges students with and without disabilities face are often met with the same tools historically found in classrooms: textbooks, pencils, paper, and calculators. These tools are useful but do not allow for extensive content manipulation allowing altered or modified representations of the classroom's instructional material. Students with and without disabilities are dependent upon traditional classroom-based instructional materials to meet their unique learning needs. The one size fits all model of curriculum delivery does not meet the needs of 21st century learners (Rose & Meyer, 2002). This outdated model of curriculum design poses significant challenges for those students who are print challenged or have other disabilities.

The future of instructional materials and curricula will place importance on the ability of the content to be altered and manipulated. These new materials and curricula will allow more ways that they can be represented to students. These various forms of content representation may include audio feedback, such as book chapters or notes being read by a computer generated voice. Digital images or pictures would also allow students to visually see and modify real world examples of concepts presented in their classroom. Video clips and 3-D models would bring live motion and video of experiments and news stories into student's individual instructional programs. Rose and Meyer (2002c) advocate curriculum designed around UDL principles (e.g., flexible presentation, expression, and engagement), so learners who have been challenged by the print-based textbook could align their approach to learning to the most appropriate form of digital content available within the curriculum.

UDL relies heavily on the utilization of educational technology. The role of technology in the classroom has historically been one filled with unmet promises and poor funding. Clark (1983) presents a critical point in regards to technology that is at the heart of UDL (Rose & Meyer, 2002). Clark (1983) argues that it is the instructional method and content, not the vehicle, in this case technology, which influences learning. This principle is supported through UDL by its framework for curriculum reform that takes advantage of new media (e.g., Digital curricula, E-text) and new technologies for learning (Hitchcock, Meyer, Rose & Jackson, 2002; Rose & Meyer, 2002). This UDL curriculum framework offers four main tenets: (1) the goal of the curriculum is to provide an appropriate challenge for all students; (2) materials must have a flexible format, supporting transformation between media and multiple representations of content to support all students' learning; (3) instructional methods are flexible and diverse enough to provide appropriate learning experiences, challenges, and support for all students; (4) assessments are sufficiently flexible to provide accurate, ongoing information that helps teachers adjust instruction and maximize learning (Hitchcock, Meyer, Rose & Jackson, 2002; Rose & Meyer, 2002; Rose, Sethuraman & Meo, 2000).

The potential of technology has been shown to make a difference in student instructional engagement time, word recognition, and comprehension but has yet to be truly integrated with the general curriculum itself while remaining as a stand alone tool separate from the daily curricula (MacArthur, Ferretti, Okolo, & Cavalier, 2001). The personal computer (PC) in the classroom has evolved from a word-processing tool into more advanced uses such as data analysis or a powerful reference source for students via the Internet. The PC and its many variations first began to provide a vehicle to alter digital content in the 1970s and 1980s by enlarging text size or altering font types and later into devices that could "speak" words using a synthetic voice the computer produced (MacArthur, 1998). Computers are now able to change the visual and auditory representation of content in multiple ways using specialized software. This category is referred to as "textreader" software. The textreader software now available serves as the link to digital content in the classroom. Currently, more digital curriculum materials are being moved online and stored on computer networks (Ekman & Quandt, 1995). These digital materials allow teachers and students to access curriculum more easily using textreader software. They allow for easier altering of the materials representation based on the student's approach to the learning task (Hartley, 1998).

New networking technologies and educational software significantly reduce the cost of school computer systems and have increased the prevalence within schools (Carlitz & Hastings, 1996). These networks allow the sharing of information and curriculum materials among classrooms, schools, and even school districts. Carlitz and Hastings (1996) note that these technological advances make it possible to provide universal computer access to school staff. They also advance the causes of educational equity and school reform by lessening the isolation of the traditional classroom and providing equal access. This networking capability allows students to gain access to new technology-based tools that provide better access to the general curriculum. The issue of curriculum access is central to UDL and this study, not technology itself. Access to computer technology is critical to the growth of UDL and is needed for students to view

ENGLISH LANGUAGE LEARNERS AND TECHNOLOGY: APPLYING UNIVERSAL DESIGN FOR LEARNING AND THE SHELTERED INSTRUCTION OBSERVATION PROTOCOL IN THE EVALUATION OF LITERACY SUPPORT SOFTWARE

A Project Report

Presented to

The Graduate Faculty

Central Washington University

In Partial Fulfillment

of the Requirements for the Degree

Master of Education

Master Teacher

by

Susan M. Connolly

November 2006

Craig A. Hughes, PhD., Advisor

CENTRAL WASHINGTON UNIVERSITY

Graduate Studies

We hereby approve the project report of

Susan M. Connolly

Candidate for the degree of Master of Education

APPROVED FOR THE GRADUATE FACULTY

______________ ______________________________
Craig A. Hughes, Ph.D., Committee Chair

______________ ______________________________
M. Cathrene Connery, Ph.D.

______________ ______________________________
Ian Loverro, Ph.D.

ABSTRACT

ENGLISH LANGUAGE LEARNERS AND TECHNOLOGY: APPLYING UNIVERSAL DESIGN FOR LEARNING AND THE SHELTERED INSTRUCTION OBSERVATION PROTOCOL IN THE EVALUATION OF LITERACY SUPPORT SOFTWARE

by

Susan M. Connolly

November 2006

The population of culturally and linguistically diverse (CLD) students in U.S. schools has been steadily increasing. These students do not experience equal educational opportunity in U.S. secondary schools. CLD students need to develop English literacy as well as content knowledge to attain equal educational opportunity. Teachers of CLD students need techniques and tools which support CLD students in mastering the content expected of secondary school students while acquiring English literacy.

The criteria for effective lesson design and delivery inherent in the Sheltered Instruction Observation Protocol (SIOP) and the criteria for designing curriculum without barriers to access inherent in Universal Design for Learning (UDL) are combined into a researcher-created assessment tool, the Literacy Support Software Evaluation Protocol (LSSEP). Nine software applications are evaluated for their effective use with CLD

students. The LSSEP is made available for use on other literacy support software by contacting the author.

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CHAPTER I

INTRODUCTION

General Problem

The population of students in U.S. schools whose first language is not English has been steadily growing (National Clearinghouse for English Acquisition, 2003). These students enter the U.S. school system with a wide range of previous school experience at a variety of grade levels (Echevarria, Vogt & Short, 2004; Ruiz-de-Velasco & Fix, 2003). Culturally and linguistically diverse (CLD) students at the secondary school level spend most, if not all, of their school day in grade-level content area classrooms (Hudelson, Poyner & Wolfe, 2003; Harklau, 1999). An inadequate number of teachers are trained in teaching strategies that support English literacy development while teaching content to CLD students (Echevarria et al., 2004). Consequently, CLD students who lack the prerequisite language skills experience great difficulty understanding the academic language inherent in mastering content at the secondary level. Without literacy support these students rarely achieve sufficient literacy skills necessary to obtain educational success or parity with their native English-speaking peers (Thomas & Collier, 1997).

Literacy support software applications are commonly used to assist students who experience a variety of barriers to literacy development and to mastery of the curriculum. These applications could be capable of providing CLD students tools which support continued literacy development in grade-level content classrooms. The purpose of this project is to understand the effectiveness of literacy support software for CLD students at the secondary level.

Background of the Problem

In the ten-year period from 1993 – 2003 the rate of increase in the CLD population was 65.03% as compared to the rate of increase for the K-12 population of 9.19% (US Department of Education, 2003). The English language proficiency of these students varies greatly. First language literacy, a key component to developing literacy in English as a second language, also varies greatly. Research shows that CLD students typically require 4 to 6 and even up to 10 years to achieve the language proficiency needed for academic success (Cummins, 1981; Thomas & Collier 1997).

Secondary students have little time to develop academic English language proficiency. They also need to master content area curriculum in order to meet the ever-growing demands of mandated testing in order to graduate from high school (Ruiz-de-Velasco & Fix, 2000). Furthermore, though second language acquisition theories widely accept the use of native language support for second language acquisition, studies show that 24% of secondary students receive native language instruction compared to 48% of elementary students (Kindler, 2002).

CLD students experience barriers to accessing the curriculum materials. Texts at the secondary level are written at an academic language level beyond the academic language proficiency of most CLD students, especially recent immigrants (Ruiz-de-Valesco & Fix, 2000). Teachers and students face a difficult task when the curriculum is presented in a format unintelligible to the student. Teachers need strategies that enable CLD students to comprehend the curriculum while continuing to develop English literacy proficiency (Echevarria et al., 2004). Two such strategies are Universal Design for Learning (UDL) and sheltered instruction.

UDL is a research based approach to reducing barriers to students' access to the curriculum (Rose & Meyer, 2002). The term universal design originates from the field of architecture (Meyer, Rose & Hitchcock, 2005). The objective of universal design is to create accessible structures by considering the wide range of access needs for all individuals. Considering the potential barriers to access during the design phase enables the resulting physical structure to be accessed by a wider range of individuals.

The concept of universal design is applied to educational settings in UDL (Meyer, et al., 2005; Rose & Meyer, 2003). The theoretical principles of UDL advocate that curriculum is chosen and classroom activities are designed to reduce barriers for students of diverse backgrounds, including language diversity. Rather than one textbook or source of content information, the curriculum incorporates a variety of sources. These sources may include, but are not limited to, electronic text, printed material, video, audio, and Internet resources. Flexible curriculum materials reduce the need for teachers to modify the curriculum for English learners (Rose & Meyer, 2002; Meyer et al., 2005; Council for Exceptional Children, 2005).

Sheltered instruction is an approach to teaching English learners content concepts while providing English literacy support (Echevarria et al., 2004). By using a variety of pedagogical strategies, such as concept modeling, graphic organizers, realia, and modified language, teachers enable English learners to continue to develop academic language skills while developing content area knowledge. The Sheltered Instruction Observation Protocol (SIOP) provides an analysis tool of effective lesson design and delivery strategies for teachers of CLD students (Echevarria et al., 2004).

Research shows the effectiveness of sheltered instruction for CLD students (Echevarria et al., 2004). Research also shows the effectiveness of UDL in reducing barriers to the curriculum for diverse learners (Meyer et al., 2005). Literacy support software applications, somewhat common in special education classrooms, are less common in grade-level content area classrooms where the vast majority of CLD students at the secondary level are educated. In this study, the theoretical concepts inherent in UDL and the pedagogical guidelines for sheltered instruction inherent in the SIOP provide a framework for evaluating literacy support software in relation to CLD students' academic needs.

Theoretical Framework

Thomas & Collier (1997) document a complex, integrated relationship between the sociocultural experiences of learners and their cognitive, academic, and language development. The Prism Model (Thomas & Collier, 1997) outlines the relationship between these four equal areas of development and provides a framework for considering the needs of CLD students. Cognitive and academic development are particularly interrelated in the school context and are considered together.

Cognitive and Academic Development

Cognitive development in children is a naturally occurring process which begins at birth and proceeds beyond the formal school years. Academic development consists of all the content area knowledge and skills attained at each grade level throughout a student's educational experiences. As the academic work advances through the grade levels, the cognitive level of the concepts also advances (Thomas & Collier, 1997).

According to Vygotsky, language and action are mediation tools used for learning (Wink & Putney, 2002). Language, a cultural heritage acquired from our interactions with others, is a dynamic tool which is used actively in the learning process. Students use language to interact with others and in doing so alter their thinking as well as develop their language and affect their actions (Wink & Putney, 2002).

The integral connection between language and thought has important implications for the cognitive and academic development of CLD students. Based upon Vygotsky's (1978) perspective, it is important for CLD students to be able to interact with other students, beyond the barriers that may exist due to the language differences between them, in order to support their learning and language development.

Students are unique individuals. While this over-simplified statement is easily accepted, it can be argued that its complexity is not always grasped. Recent brain research reveals "that there are no 'regular' students. The notion of broad categories of learners – smart, not smart, disabled, not disabled, regular, not regular – is a gross oversimplification that does not reflect reality. By categorizing students in this way, we miss many subtle and important qualities and focus instead on a single characteristic" (Rose & Meyer, 2002, p. 38).

Vygotsky's concept of the Zone of Proximal Development (ZPD) adds further understanding to the uniqueness of learners. The ZPD is the difference between a student's actual developmental level and the potential developmental level which the student can achieve with assistance from an adult or more capable peer (Vygotsky, 1978). Students learn best when activities are directed within their ZPD (Wink & Putney, 2002). Providing CLD students with learning opportunities targeted within the ZPD leads the students' development and "makes it possible to assume that good teaching can lead to good learning, which in turn can lead to more development" (Wink & Putney, 2002, p.95). Addressing CLD students' unique learning needs by targeting their ZPD, when viewed through the lens of Vygotsky's theories, becomes an integral part of supporting students' cognitive and academic as well as literacy and language development.

Language Development

Language development consists of all associated skills of oral and written language systems which include vocabulary, syntax, morphology, semantics, pragmatics, discourse and paralinguistics (Thomas & Collier, 1997). Attention to language development in students' first and second languages is integral to their academic and cognitive development. (Thomas & Collier, 1997; Cummins, 2001).

Krashen (1982) proposes a distinction between the learning of a language and the acquisition of a language. Learning a language is the result of direct instruction and consists of knowledge of the rules and grammatical structure of the language. Acquisition is a subconscious process which results from naturally occurring opportunities for meaningful communication. According to Krashen (1982), language acquisition progresses in a natural order.

Understanding the difference between learning and acquiring a language has important implications for the education of CLD students.

CLD students' language proficiency will develop as attention is given to acquisition of the language and the order in which it is acquired; CLD students need much more than a focus on the grammar and structure of the English language (Krashen, 1982; Echevarria et al., 2004; Thomas & Collier, 1997).

The academic language needs of CLD students are often overlooked (Cummins, 1979). CLD students who have acquired sufficient English to become proficient in using English in social settings are often thought to be equally proficient in academic settings. According to Cummins (2001), social language skills, commonly referred to as Basic Interpersonal Communication Skills (BICS), are more contextually embedded and less cognitively demanding than language used in academic settings, referred to as Cognitive Academic Language Proficiency (CALP). The content-specific vocabulary and processes in CALP consist of a more complex skill level of language use and require instruction to master (Cummins, 1979). Attention to the development of both types of language is important for CLD students. Evaluating students or determining programming needs based upon BICS alone results in students who lack the requisite academic language skills needed for success in secondary content classrooms (Freeman, Freeman & Mercuri, 2005; Echevarria et al., 2004; Cummins, 2001; Chamot & O'Malley, 1994).

Sociocultural Development

The Prism Model developed by Thomas & Collier (1997) states that CLD students' academic, language, and cognitive development are affected by the socio-cultural experiences of their lives, not only in the instructional classroom but also in the school and in the larger community. Vyogostky asserts that learning occurs through students' active interactions with others (Wink & Putney, 2002). CLD students' language development is affected by factors such as teacher-student as well as student-student interactions. CLD students benefit from educational experiences which create a supportive sociocultural environment for all students (Thomas & Collier, 1997).

Project Objective

The academic success of CLD students educated in U.S. schools is dependent upon attention to each of the factors outlined above. This project used these concepts to evaluate literacy support software applications and their applicable use for CLD students.

Methodology

The researcher used the criteria for effective lesson design and delivery from the SIOP and the theoretical framework for flexible curriculum design from UDL to create an assessment tool. The Literacy Support Software Evaluation Protocol (LSSEP), created in Microsoft Excel, consists of a series of questions. The LSSEP was applied to nine literacy support applications.

Remainder of the Project

The concepts introduced in Chapter I of this project will be further developed and explored through a review of the literature in Chapter II. Chapter III discusses the procedure used to develop the LSSEP, delineates the relationship between the criteria and the LSSEP, and explains how the LSSEP is used. Chapter IV is a description of the software applications evaluated in this project and a discussion of the findings. Chapter V discusses the implications of this project for CLD students and their teachers as well as outlines further steps which could be taken in using the LSSEP and the literacy support software applications for CLD students in secondary content classrooms.

Definition of Terms

Activity based learning: Students interact with content concepts through a wide variety of computer-based interactive tasks. Examples include creating talking, animated stories or moving objects on the screen to complete tasks. Content concepts can be developed, reinforced, or practiced throughout the activity.

Animation: Graphic objects on screen appear to move, change position or size, vibrate, or in some other fashion give the impression of movement.

Embedding: Teachers can place links, notes, voice recorded messages, and visual or auditory prompts into text or activities. In some software, these embedded objects, notes, or links show up automatically and in other software embedded objects can be hidden or revealed with simple mouse or on-screen button clicks.

Portable document file (PDF): A PDF (appears as title.pdf) is a document file that displays all the elements of a printed document as an electronic or digital image. Specific software is required in order to access PDF files. Free software to access PDF files, such as Acrobat Reader, can easily be downloaded.

Rich text files (RTF): RTF (appears as title.rtf) refers to document files that can be easily exchanged between different text-handling applications and platforms including word processing software. Most formatting, such as font and margins, are maintained.

Speech recognition (speech-to-text): Speech recognition is used to convert spoken words into printed text. Speech recognition requires a computer with sufficient processing capabilities, a microphone, and advance preparation with the computer to create a voice file so that the computer can identify the individual vocal patterns of the speaker.

Text reader (text-to-speech): Text readers use speech synthesis technology to produce human like voices which speak text as it appears on the screen.

Voice file: A voice file is a collection of the individual vocal patterns of a speaker. It is created when the user trains the computer during the preparation phase for speech recognition. Typically, the speaker is asked to read selections into a microphone while the computer creates the voice file.

Word prediction: Word prediction is a feature which supports students as they write on the computer by displaying a list of word choices. The list changes as each letter is typed allowing for greater specification of the word the student is seeking. When the desired word appears the student can select the word and it will automatically be inserted into their writing.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Students educated in the U.S. school system are entitled to a quality education, regardless of their background, abilities, culture, or first language. As the population of culturally and linguistically diverse (CLD) students continues to rise, schools systems face ever increasing challenges of providing equal educational opportunity for all students.

CLD students benefit from specialized teaching approaches which enable them to obtain a quality education. Most CLD students at the secondary school level spend most if not all of their day in content classrooms if they are not in isolated ESL classrooms (Hudelson et al., 2003;Harklau, 1999). Not enough content teachers are trained in effective methods for teaching CLD students (Echevarria et al., 2004). CLD students educated in content classrooms with teachers not trained in effective techniques to meet their needs suffer low achievement in comparison to their native English-speaking peers (Thomas & Collier, 1997).

Content classroom teachers need resources and training specific to teaching CLD students. One source of effective resources is appropriate technology (Padrón & Waxman, 1996). Other resources include the SIOP and UDL. This project provides an evaluation of nine literacy support

STUDENTS WITH DISABILITIES: POST-SECONDARY VOICES AND UNIVERSAL DESIGN FOR LEARNING

by

Shirley Ann Coomber
B.Ed. (Education), UBC, 1978
M.Ed. (Counselling Psychology), UBC, 1986

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EXAMINING COMMITTEE:

Chair Michael Ling

____
Eugenie Samier, Associate Professor
Senior Supervisor

____
Jean Campbell,Associate Dean, Camosun College
Member

____
Maureen Hoskyn, Assistant Professor
Member

____
Dr. Michele Schmidt, Faculty of Education
External Examiner

____
Dr. Timothy Stainton, Associate Professor, University of British Columbia, Faculty of Arts, School of Social Work and Family Studies, 232 - 2080 West Mall, Vancouver, BC V6T 1Z4
Examiner

Date August 1, 2006

ABSTRACT

Human rights legislation has supported the provision of disability support services for twenty years within the public post-secondary system in British Columbia. However, most institutions and their students with disabilities have faced the challenge of disparate views regarding access to learning. The purposes of this study are rooted in a discourse of equality and social justice: how can the educational community maximize academic access for students with disabilities so that they can benefit from the opportunities that higher education affords other members of society?

Universal design for learning is purported to enhance access for *all* students with diverse learning needs. Within this framework, teaching is designed to meet the needs of students' learning differences by providing multiple means of acquiring information, engaging learner interest, and demonstrating knowledge. The findings of this study contribute to an emerging body of scholarly literature on the effectiveness and implementation of curricula-based access. The purposes of the project were to better understand how social experiences among students and faculty, situational constraints, and organizational demands impact practices related to teaching and learning, as well as whether educational leaders can respond to concerns about access, given the structures they are situated within.

Students with disabilities and faculty in an urban post-secondary institution were interviewed to determine how they are positioned within the organizational culture related to academic access. The principles and practices of universal design for learning were utilized as a framework for analysis. An exploration of case law that flows from the *BC Human Rights Code* (1996), and the policy and practices that have evolved from it, were also central to the inquiry.

The study's findings reveal that both students and faculty are unfamiliar with the legal framework, but value the practices associated with universal design for learning. However, developing new interpretations of academic access for students with disabilities will be a challenge. Social structural changes are required to create space for providing access for students through instruction. Ongoing dialogue within the educational community, professional development opportunities, and attention paid to academic access policies are the touchstones by which educational leaders would transform disability access.

DEDICATION

For my husband, Marc Gawthrop, who provided steadfast support, encouragement, and patience for this project, and my parents, Emily and Len Coomber, who taught me the determination to finish what you start, to act with integrity, and be the best you can be in all situations.

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CHAPTER 1
UNDERSTANDING DISABILITY: EMBRACING DIFFERENCES

1.1 Introduction

Yet, at a deeper level, and independent of population figures, disability is not at all a distinguishing feature of a group of individuals . . . it is rather an essential feature of the human condition. (Bickenbach 2001, 580)

My motivation for undertaking this study grew from a belief that the educational community has a professional and social obligation to address possible barriers in access to learning that students with disabilities encounter in public post-secondary education in British Columbia (BC). More than twenty years experience in the fields of counselling, teaching and disability services leads me to suspect that a lack of dialogue, informed by our values and beliefs, has resulted in a devaluation of the differences that constitute the character of students with disabilities. Disparate views on accommodation processes in higher education, reported in scholarly research (e.g., Beilke & Yssel 1999; Bento 1996; Bourke et al. 2000; Leyser et al. 1998; Long et al. 1999; Low 1996; Maudaus et al. 2003a; McEldowney Jensen et al. 2004; Rice-Mason 2001; Vogel et al. 1999), parallel those found among my colleagues and students in my professional practice. Some students with disabilities face challenges in accessing the accommodations that they feel are required for academic access. The formulation of my thesis topic and research design was the result of continually evolving interpretations of this social problem.

My interest in these issues grew into an intellectual curiosity regarding the efficacy of universal design for learning (UDL) as a model of access for students with disabilities.[1] I was particularly curious about how students with disabilities and faculty experience access through curricula design and the factors that influence their perceptions. Within this framework, teaching is customized to meet the needs of students' learning differences by providing multiple means of acquiring information, engaging learner interest and motivation, as well as demonstrating knowledge. Proponents of this approach maintain that it could reduce the possible stigma associated with the provision of individual accommodations, and provide a greater sense of equity and fairness for all students (Bowe 2000; Higbee 2001; Johnson & Fox 2003; Embry et al. 2005; Scott et al. 2003a, 2003b; Silver 2003; Strauss & Kroeger 2003).

The first section of this chapter presents the research purposes, objectives and significance of the project, as well as how these evolved. In the second section, the contextual factors that impinge on academic access for students with

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[1] For the purposes of this thesis, the term "universal design for learning" or "UDL" will be used to reflect the principles and practices of curricula-based accommodations as a means of providing academic access for post-secondary students with disabilities.

disabilities are developed to situate the practices associated with UDL within post-secondary settings in Canada and the United States (US), and as a component in the iterative process of formulating the study's research questions. The research questions that emerged from this analysis, and the study's scope and limitations, are reviewed in the final section of the chapter. Throughout this project I have made my values, beliefs, and professional practices explicit, and describe how they are intimately connected to the social context of disability issues and higher education. When I began this project, I was beginning a journey that cleared the lens through which I viewed the lives of students with disabilities. What counts as authority? What had I taken for granted? What was not true in the schema in which I had grounded my practice in the past?

Reflecting on current academic access practices led to an unexpected realization about the lens through which I viewed my professional practice. My initial thinking about academic access for students with disabilities was partly entrenched in the "truths" of the dominant legal order and a medical model of disability, and that had not been challenged for some time. As I began to heighten my awareness of the practices that impinge on access to learning, the social nature of creativity deeply resonated with me. This led me to wonder how members of the educational community create discrimination based on disability, and what impact the social construction of disability has on access to learning. Gergen (1999) points to the range of outlooks within dialogues on the social construction of reality. Within his view, the primary emphasis is on "discourse [as] the vehicle through which self and world are articulated, and the way in which such discourse functions within social relationships" (60). In this study, Gergen's view is complemented by a view of sociological constructivism where the emphasis is on the way "understandings of self and worlds are influenced by the power that social structures (such as schools, science and government) exert over people" (60).

1.2 Purposes, Objectives and Significance

Questions of ideology are best examined within the context of articulating the purpose of scholarship.
(Goodman 1998, 53)

This section of the chapter is a reflection of my current theories, frames of reference and world views and how they have shaped this study. The primary purposes of this project are to contribute to research knowledge, and improve my professional practice through a better understanding of the underpinnings of practices that provide academic access for students with disabilities. The aim is to explore how inclusive and non-inclusive practices are linked to social constructions of disability in public post-secondary culture.[2] How are students with disabilities and faculty positioned within these practices? What is the complexion of human agency related to academic access for students with disabilities and faculty? Exploring instructors' approaches to course design,

[2] Geertz (1973) defines culture as "the fabric of meaning in terms of which human beings interpret their experience and guide their action" (145).

teaching and evaluation, as well as the impact of the *Canadian Charter of Rights and Freedoms* (1982) and the legislation, institutions, policies, and practices that enshrine it are central to the inquiry. Through this critical analysis, possibilities for promoting access to learning for students with disabilities through universal design for learning will become clear.

My professional purpose was rooted in a discourse of equality and social justice: how can the educational community maximize access to learning for students with disabilities so that they can benefit from the opportunities and advantages that public post-secondary education affords other members of society? The principles and concepts of UDL challenge us to re-think the practice of providing disability access within a learning community that embraces differences. However, educators need to consider the rights of *all* students and at the same time ensure that the integrity of academic standards remains intact. Can educational leaders respond to the issues and concerns about access to learning within the structures wherein they are situated? What forms of governance, policy development, resource allocation, and educational practices could reflect a barrier-free pedagogy within the web of power, politics, and bureaucratic ethos pervasive in public institutions – Weber's evocative metaphor of an iron cage (Barnes et al. 1999, 36-37; Turner 2001, 255)?

Harrison (2004) maintains that "teacher-centered education is rooted in centuries of tradition: lecture, note-taking, a mid-term and a final" where faculty are trained as content experts. Students with disabilities often require support services in order to access curricula designed and delivered in this manner. In contrast, learner-centered teaching focuses on choices, active learning that encourages reflection, integration and critical thinking, interactivity, frequent feedback and varied approaches to instruction and evaluation. While the delivery of content remains a central aspect of higher education, the strategies associated with collaborative learner-centered education provide students with experiences in "collaborative behavior, positive interdependence, and individual *and* group accountability *and* responsibility" (LeJeune 2003, emphasis in the original). This framework evokes the principles of UDL. Scholars associated with the Ivy Access Initiative at Brown University describe this alternate paradigm of access as

> instructional materials and activities that allow learning goals to be achieved by individuals with wide differences in their abilities to see, hear, speak, move, read, write . . . attend, organize, engage, and remember. . . [It] acknowledges differences among students and uses them to strengthen the learning process. (Brown University 2002)[3]

An important objective of the research was to give voice to the lived experiences of students with disabilities and faculty. The study investigates how students and instructors establish and sustain the meaning of disability and access to higher education. In other words, as Kelly (2001) purports, "personal experience becomes social experience in relationships with other people" (396). How do social experiences or relationships with other people regarding disability relate to community, human agency, and action? I was also seeking an understanding of

[3] The Ivy Access Initiative is a joint venture between educators at Brown University, Columbia University, Dartmouth College, Harvard University, and Stanford University.

the situational constraints and organizational demands that emerge through human interaction. Specifically, I explored the interface of disability constructs with the realities of a new and complex world.

A market driven agenda has taken on accelerated levels of power in the post-secondary system, fuelling the continued growth of science, instrumental reason, and autonomy in a way that supports economic benefits for individuals (Barnes et al. 1999, 36-37; Turner 2001, 255). These influences led me to ask what effects these factors have on the provision of academic access. Drawing on the work of scholars in educational administration and other fields who are committed to a valuational approach to leadership (e.g., Bates 1989; Beck & Foster 1999; Burns 1978; Foster 1989; Forester 1999; Franklin 1999; Garofalo & Geuras 1999; Gutmann & Thompson 1996; Harris 2003; Samier 2002), an essential theme in my thesis is how the bureaucratization of educational life and the current political and economic agendas in BC can work in oppressive ways against community members.

McGuire et al. (2003) caution that researchers should remain cognizant of a "bandwagon" effect whereby new models of access become popular before having passed a rigorous validation process (17). Although the conceptual framework of universal design for learning appears well developed, there is currently a paucity of empirical evidence regarding the efficacy of this model (Embry et al. 2005; McGuire & Scott 2002; McGuire et al. 2003; Romereim-Holmes & Schade 2003; Scott et al. 2003; Silver et al. 1998; Silver 2003). The findings of this study contribute to an emerging body of scholarly literature on the effectiveness and implementation of UDL as a potential educational access model. Exploring the thinking of participants about approaches to teaching, learning, and evaluation was particularly relevant in light of changing delivery modes and the impact on access to learning for students with disabilities.

While much has been written about the legal model of access to learning, very little attention has been paid to how participation in an educational community creates meaning regarding disability and academic access. Discovering how participants internalize their experiences of inclusive and non-inclusive practices within the educational community could lead to a better understanding of factors that buttress access to learning and student success. Little is understood about the ways students with disabilities and faculty socially construct disability, experience educational practices within the cultural landscape, or about their experiences as agents of change (Kalivoda & Totty 2003; Scott et al. 2003a; Silver et al. 1998). The inquiry also begins to fill a gap in research knowledge regarding the impacts of the biological and socio-cultural models of disability through better understanding participants' experiences of educational access, and the impact on their self-concepts, sense of community, and agency. Finally, the study is designed to make a unique contribution to research knowledge regarding the systemic supports and barriers students with disabilities and faculty experience in acquiring and providing academic access to post-secondary education. Identifying the complexities of leadership that address dimensions of change that support an enhanced model of disability access may assist educational leaders in the difficult process of social and cultural transformation.

1.3 Contextual Relationships

Critical inquiry focuses on contradictions as a starting point for the process of ideology critique. (Lather 1986, 278)

It is critical that a research design reflect clarity of thought. Maxwell (1996) explains that "the conceptual context of your study - the system of concepts, assumptions, expectations, beliefs and theories that supports and informs your research - is a key part of your design" (Maxwell 1996, 25). A contextual framework explains, either graphically or in narrative form, the concepts to be studied – the key factors, constructs or variables – and the presumed relationships between them (Miles & Huberman 1994, 18). When I began to explore my research interests, it quickly became apparent that I held unexamined prejudices that required a deep dialogue with the scholarly literature I was reviewing. My goal was to explore underlying processes and meanings in a manner that would not merely reinforce preconceived notions. The bracketing process remained a challenge throughout the project.[4] Part of the challenge lay in separating productive prejudices that enabled understanding of access practices. Were my biases legitimate based on a review of scholarly literature

[4] The term "bracketing" is used here in its classic Gadamerian sense where a suspension of the antecedents of understanding is required in order to allow the text to ask its own questions (Anderson et al. 1986, 74-76; Bowie 2003, 253).

and critical self-reflection? This process was invaluable in developing the contextual relationships that framed the study, research questions, and methods, as well as for the evaluation of threats to trustworthiness. In this section of the chapter, I explore the contextual factors that impact academic access for students with disabilities including: constructions of disability; social justice and equality; access to learning; the cultural landscape in public higher education, and leadership practices.

1.3.1 Legal and Political Landscape

Smith (2000) comments on how the foundation of human rights legislation in Canada upholds the courts' interpretations, which reflect socially constructed case law that is constantly evolving:

> In the case of the constitutional equality guarantees, the Canadian courts have broken new ground and have taken a substantive . . . approach to equality. This substantive approach . . . means the question is not whether similarly situated people are treated similarly, but whether historically disadvantaged groups face a lack of equality in their political, social, or economic position. (22)

The *Canadian Charter of Rights and Freedoms* (1982) and provincial human rights legislation in BC reflect the values of equality of opportunity and social justice that define Canadian culture. Sussel (1994) notes that Section 15.1 reflects the constitution's substantive equality guarantees, and is widely viewed as being the central feature, having application to a broad range of social policy issues (58-60):

> Every individual is equal before and under the law and has the right to the equal protection and equal benefit of the law without discrimination and, in particular, without discrimination based on race, national or ethnic origin, colour, religion, sex, age or mental or physical disability. (Government of Canada 1982)

The *BC Human Rights Code* (1996) evolved in response to the principles of the *Canadian Charter of Rights and Freedoms* (1982), over-riding institutional collective agreements, or any other law, statute or contract that has an impact on the human rights of British Columbians (Price 2003). Section 8.1 of the *BC Human Rights Code (1996)* has set a high standard for the extent to which public schools have a duty to accommodate students with disabilities:

> A person must not, without a bona fide and reasonable justification, a) deny to a person or class of persons any accommodation, service or facility customarily available to the public, or b) discriminate against a person or class of persons regarding any accommodation, service or facility customarily available to the public because of race, color, ancestry, place of origin, religion, marital status, family status, physical or mental disability, sex or sexual orientation of that person or class of persons. (Government of British Columbia 1996)

This Canadian view of social justice and equality is summarized in a landmark decision by Mr. Justice McIntyre when he comments on the nature of discrimination:

> A distinction whether intentional or not but based on grounds relating to the personal characteristics of an individual or group, which has the effect of imposing burdens, obligations, or disadvantages on such individual or group but not imposed upon others, or which withholds or limits access to opportunities, benefits and advantages available to other members of society. Distinctions based on personal characteristics attributed to an individual solely on the basis of association with a group will rarely escape the charge of discrimination, while those based on an individual's merits

A Universal Design for Learning Mathematics: Reducing Barriers to Solving Word Problems

By

Merry L. Staulters

A

Dissertation submitted to the University at Albany, State University of New York

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A Universal Design for Learning Mathematics: Reducing Barriers to Solving Word Problems

By

Merry L. Staulters

Abstract

A multiple-case study design was employed to investigate how Universal Design for Learning (UDL) procedures (CAST, 2002; Rose & Meyer, 2002), and commonly available technology applied to word problems in mathematics assisted five diverse learners to reduce print and working memory related barriers. In addition, the effects on student engagement with and self-efficacy for solving word problems was also studied.

Students need to be competent at solving math word problems to meet the required educational standards and, most importantly, to demonstrate proficiency in using mathematics to solve real life problems (Wilson & Sindelar, 1991). This study focused on providing an in-depth perspective on difficulties experienced by five learners who exhibited deficits in mathematical word problem solving. Information from barrier analyses was applied to develop digitized math word problems that were used to teach learners to problem solve more effectively. The digitized problems were modified to contain hidden comments accessible by the learner if s/he experienced problems with decoding or comprehending the text. In addition, the problems contained hints to prompt the learner to use strategies for: identifying relevant information, visualizing the context, fact retrieval, and process application.

While prior studies have examined the relationships between working memory deficits (Swanson, & Beebe-Frankenberger, 2004), or reading disability (Fuchs, Fuchs, & Prentice, 2004; Owen & Fuchs, 2002), and word problem solving in mathematics, few have been able to assist educators by offering practical suggestions for reducing these barriers. Research has indicated that the application of Universal Design for Learning, including the use of hypermedia, can incorporate many of the well-researched instructional practices characteristically delivered through traditional instruction

(Hitchcock, Meyer, Rose, & Jackson, 2002; Pisha & Coyne, 2001; Rose & Meyer, 2002). This study contributes to this research by demonstrating the value of using technology to support the learner's ability to encode, plan and execute strategies, as well as to increase motivation for the problem solving task. Recommendations for educators are offered to promote the usefulness of this word problem solving intervention.

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I appreciate the backing that I received from the Higher Education Support Center through Syracuse University. Their contribution certainly made the process much more manageable for me.

To my two sons, Anthony and Zachary, thank you for respecting the time, and the commitment I had to give to this venture. You often didn’t get to go on outings because I was working and couldn’t take you. You often had to walk quietly in the house, be the one to take the dogs out, and eat many meals from cardboard boxes so that I could finish “my writing.” I am done now, so let’s go to the Great Escape.

Finally, to my husband Wes, this endeavor has encompassed so many of the years we have had together. You have never complained about or criticized my need to do this. You also ate many unfit meals, took the kids to practices, did loads (and loads) of laundry, and never asked me to be anything other than what I am. You most of all have stood unwavering in your faith that someday, I would finally graduate, again, and for the last time. I promise this will be the last time.

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CHAPTER 1

INTRODUCTION

The purpose of this investigation was to examine the effects of a universally designed approach to teaching students to solve mathematical word problems. The following topics are introduced in this chapter: recent State and Federal mandates requiring the implementation of educational standards and compelling access to the general curriculum for students with disabilities, the importance of mathematics in relation to the learning standards, a rationale for addressing verbal problem solving, and a rationale for applying Universal Design for Learning theory. Finally, the problem under investigation is explained and terms and types of word problems are defined.

Federal and State Mandates and Standards

Recently, the educational community has focused on the means, methods, principles and policies of current practice. Much ado is being made over recent changes in educational mandates and new National and State education standards. Heightened academic standards created by task forces, National councils, and State governments (Kendall & Williams, 2004) play an essential role in education reform and have affected changes that are felt by administrators, teachers, students, and families alike (Marzano & Kendall, 1995; Nolet, & McLaughin, 2000). Simultaneous to the development of these new standards is the ongoing change in expectations for schools related to the education of children with disabilities. The Individuals with Disabilities Education Act (IDEA, 1997) and the No Child Left Behind Act (2000) have created unique challenges for our education system (Hitchcock, Meyer, Rose, & Jackson, 2002; Thurlow, 2000; Thurlow, 2002). Special education laws first initiated in the 1970s, and since revised, have increased the learner diversity within our classrooms, and have required school communities to improve the access, participation and success in the general education curriculum for those learners with disabilities (IDEA, 1997; IDEA, 2004).

While Federal and State standards require that schools rise to the challenge of ensuring that all students successfully meet these heightened expectations, many learners continue to experience difficulty within the general education environment (Bottge & Hasselbring, 1993). Educators are feeling pressured to address more content material in order to improve scores on standardized tests of achievement (Defur, 2002; Tomlinson, 2000). A recent opinion is that linking standardized learning outcomes to educational objectives will promote improvements in instruction and the scores on assessments designed to measure achievement (Berry, 2003; NCTM, 1998; Voltz, Sims, Nelson, & Bivens, 2005).

According to former Assistant Secretary of Education, Diane Ravitch (1995), standards are a natural part of our governing system. They are crucial not just to education, but also to governing the practices administered by businesses, food service industries and the agricultural community. Standards regulate working conditions and practices for the production of many of the items we purchase and the services we employ. Just as standards improve and protect the quality of our food, they can preserve and enrich the quality of education provided within our schools. In Ravitch's own words, "[Learning] Standards can improve achievement by clearly defining what is to be taught and what kind of performance is expected." (p. 25). Conversely, Carol Tomlinson (2000) argues that pressure to attain uniform learning standards and show success on mandated assessments may compel educators to try teaching more content through less effective means. Findings from the Third International Mathematics and Science Study (TIMMS) suggest that mathematics teachers in the United States spend less time developing concepts, particularly in the area of problem solving, in an attempt to address a greater number of topics than teachers in other countries (Stigler & Hiebert, 1999). Forcing a standards based education may be in conflict with good instruction and Tomlinson suggests that standards should serve to "establish a common direction, ensure some equity in learning goals, and provide a ready means of communication among educators as well as parents and the community…" (Tomlinson, 1999b, p. 14). However, simply informing teachers of the standards does little to provide them with the pedagogical knowledge necessary to insure that all learners will meet them.

At the same time that standards have been raised, the inclusion movement has assured that greater numbers of students with disabilities are being placed in general education settings. Some annual education reports reveal that more students with disabilities are spending more than 80% of their school day in general education classrooms (Annual Report, NYSED, 2002-03; U.S. Department of Education, 2002). These students have widely differing language, learning, social, and behavioral needs (Moats, 2004; Fuchs, Fuchs, & Prentice, 2004; Jitendra, Edwards, Starosta, Sacks, Jacobson, & Choutka, 2004). They may have significant differences in their levels of cognitive, communication, physical and social abilities. Classrooms are heterogeneous in their academic levels as students considered gifted and talented are educated among students without disabilities, as well as with those who have mild, moderate, or severe disabilities. National special education law (IDEA, 1997; IDEA, 2004) requires that students with disabilities have access to the same curriculum and educational standards that non-disabled students are afforded. Accountability for progress toward achieving the standards is assured by requiring that students with disabilities be assessed by the same state and district wide measures as those students without disabilities (Pugach & Warger, 2001; Rose, 2000).

The conditions necessary for educators to succeed are exacting, and require that teachers be highly competent in a variety of pedagogical strategies and approaches that will help all students learn (Smilkstein, 2003). In particular, students with disabilities frequently experience difficulties in their ability to master the skills identified within the standards for some or all of the content areas (Pisha & Coyne, 2001). Educators must provide specially designed instruction which sufficiently meets the needs of diverse learners and guarantees their success in the general curriculum (Hitchcock, Meyer, Rose, & Jackson, 2002; Hitchcock & Stahl, 2003; Pugach & Warger, 2001). While it is widely recognized that students with disabilities and those considered gifted and talented can benefit from adapted curriculum, materials, and methodologies, the preparation and implementation of these adaptations can be time consuming and arduous to apply (Moon, Callahan & Tomlinson, 1999a; Pisha & Coyne, 2001). Currently educators are seeking more efficient and individualized approaches to help learners acquire, organize and produce knowledge relating to the standards (Ellis & Sabornie, 1990). These approaches must be practical to create and use, and must enhance performance on standards related assessments.

The Importance of Mathematics in Relation to the Standards

One content area currently receiving a great deal of attention for standards based instruction and assessment is mathematics. The National Council for Teachers of Mathematics (NCTM) has greatly influenced the direction of mathematics instruction in the United States with its publication: Professional Standards for Teaching Mathematics (1989) and Assessment Standards for School Mathematics (1995). NCTM revised its standards and published Principles and Standard for School Mathematics organizing and identifying specific content and benchmarks for introducing and instructing each concept (2000). These more recent principles and standards, "describe particular features of high quality mathematics and education and the mathematical content and processes that students should learn." (p. 11). In addition, NCTM suggests that "Students must learn mathematics with understanding, actively building new knowledge from experience and old knowledge" (NCTM 2000, p. 22). Administrators, teachers, and families are searching for the means to facilitate the level of learning necessary for students to meet these standards and to demonstrate their knowledge in a meaningful manner.

The Importance of Solving Word Problems

Problem solving has been identified by the NCTM as one of ten principle standards in math education (NCTM, 2000). According to the NCTM, "Problem solving is an integral part of all mathematics learning. In everyday life and in the workplace, being able to solve problems can lead to great advantages." (p. 18). In fact, in the 1989 Agenda for Action, the NCTM identified problem solving as a number one priority for math instruction. It has been recognized that students in the United States demonstrate poorer performance in the area of mathematics, particularly in solving word problem tasks, than those in many other nations (National Center for Education Statistics, [NCES], 1991, 1992). Word problems not only serve to relate the purpose of mathematics to real life situations, they teach us to solve mathematical problems that allow us to grow to be independent and productive citizens (Wilson & Sindelar, 1991). Learning to problem solve should be an integral part of mathematics instruction for all students and must involve all Content Standards (NCTM, 2000).

Word Problem Solving with Students Who Have Learning Disabilities

Researchers have suggested that perhaps as many as 4 to 7% of school age students have a disability in the area of mathematics (Lewis, Hitch & Walker, 1994). One standard that is particularly problematic to many students is word problem solving (NCTM, 1989; 2000). According to the NCTM, problem solving is an integral part of all mathematics learning (2000, p. 52). Word problems, and written word problems in particular, present challenges for many students, but those with learning difficulties in language or mathematics experience the greatest failure in this skill (Carnine, 1997; Miller & Mercer, 1997; Fuchs, Fuchs, Prentice, 2004). Gallagher-Landi (2001) asserts that word problems present great difficulties to students who may have deficiencies in reading, computation, or in both. Studies have suggested that students with learning disabilities perform at significantly lower grade levels in mathematics than their non-disabled peers. Reportedly some students with disabilities may spend more than a third of their special education instruction time on problem solving alone (Carpenter, 1985). Cawley and Miller (1989) found that some students with learning disabilities in grades three and four were performing at first grade math levels, particularly in skills requiring them to solve applied word problems. Likewise, a study by Carnine, Jones and Dixon (1994) showed that tenth and eleventh grade students with disabilities performed as low as fifth grade levels in mathematical word problem solving.

Word Problem Solving Instruction

Traditional approaches to teaching children to solve mathematical word problems have incorporated a great deal of teacher lead demonstration combined with drill and practice (Montague, Warger, & Morgan, 2000). There has been tremendous emphasis on rote memorization of functions, facts, key vocabulary and procedures rather than on the development of the concept, reasoning or application to real world situations (Frykholm, 2004; Jitendra, DiPipi, & Perron-Jones, 2002). However, successful problem solvers use more than memorization of facts, vocabulary and procedures; they learn to construct a meaningful abstract representation upon which the process can build (Carpenter, Moser, & Bebout, 1988). They form mental depictions of the quantitative elements and their relationships within the context of the problem to identify details essential to finding the correct relationship and to determining the function(s) necessary to correctly solve it (Bernardo, 2002; Lewis, 1989). The relevant elements and their relationship are commonly known as the problem structure (Bernardo, 2002). Traditional approaches fail to sufficiently scaffold the experience of creating mental representations which allow learners to decipher relationships using reasoning, rather than memorization to solve problems. Therefore the application of the problem solving skill is limited and less easily generalized. The learner's skills fail to develop efficiently and problem solving ability is restricted to highly familiar problems which contain similar language and situations (Wright & Wright, 1984).

Textbook Approaches

Educators often rely on textbooks as the primary instructional resource (Pisha & Coyne, 2001). However, textbooks have several drawbacks. First they are unimodal in their approach in that they lend themselves to a visual learning style only (Meyer & O"Neill, 2000). Second, the word problems found in textbooks may restrict exposure to a topic, may not stimulate student interest and often do not allow the learner to relate real life incidents to the concepts they are trying to teach (American Association for the Advancement of Science [AAAS], 1989, 1993, 1996). Third, textbook authors often view word problems as more difficult than symbolically represented problems. Researchers who have analyzed textbooks to determine their approach to instructing word problems have often found that new constructs are typically presented in symbolic form and only later are the constructs represented in word problems, and then they are commonly addressed only as challenge questions (Nathan, Long & Alibali, 2002). This practice limits exposure to, and practice for, the process of solving word problems. Fourth, textbook publishers may be driven by demands of specific state regulations as some states provide publishers with detailed requirements regarding topics and material to be included. As a result, the texts may attempt to teach too many concepts too little depth. Key ideas may not be diversely represented and narrowed opinions may be depicted (Bradley, 1999). Fifth, the reading level of the text may be too difficult for many students. Many textbooks are designed using formulas to measure readability and to produce a grade level score. The level of complexity is determined by the number of multi-syllabic words, sentence length and word familiarity. Although textbook publishers may use readability scores with the intention of creating texts at a proposed grade level, readability formulas used to create passages show variances in readability of up to 6.2 grade levels (Chambliss, 1994). In addition, publishers who attempt to use readability scores as the measure of difficulty fail to account for the importance of interest, organization or contextual clues that may support struggling readers. Therefore, the reader's ability to comprehend becomes even more limited.

All too often, textbooks are used to introduce new concepts and skills. A number of studies have suggested that students benefit from a more active participation with the material prior to reading it in a text (Davey, & Kapinus, 1985; Eldridge & Quinn, 1988). Students demonstrate greater success completing textbook problems when they come to the material with prior knowledge of and a solid understanding of the concept. Educators should reserve the use of textbooks until students have developed a sound conceptual understanding of the content using manipulatives.

Artículos Científicos

WOULD YOU RECOGNIZE UNIVERSAL DESIGN FOR LEARNING IF YOU SAW IT? TEN PROPOSITIONS FOR NEW DIRECTIONS FOR THE SECOND DECADE OF UDL

Dave L. Edyburn

Abstract. As I read the latest issue of the *Learning Disability Quarterly,* I was appreciative of the essay by King-Sears (2009) highlighting the value of universal design for learning (UDL) to the learning disability community. The allure of UDL has captured the imagination of many educators and policy makers. The recent reauthorization of the Higher Education Opportunity Act of 2008 (Public Law 110-315, Section 202, I, A), for example, requires colleges of education that receive federal funding for teacher quality partnership grants to report on the outcomes of UDL training within their preservice preparation programs. King-Sears' efforts to encourage the learning disability community to dialogue about UDL are noteworthy and timely.

Given that the King-Sears piece was featured as a "Commentary" article designed to spark conversation about contemporary topics, I would like to take this opportunity to extend the conversation and highlight nuances associated with translating UDL theory into practice. As someone who has been involved in helping individual teachers as well as schools, states, provinces, and policy makers translate UDL theory into practice, I am concerned about the ability of the profession to implement a construct that it cannot define.

DAVE L. EDYBURN, Ph.D., Department of Exceptional Education, University of Wisconsin-Milwaukee.

HISTORICAL CONTEXT

As King-Sears (2009) noted, the origin of the term *universal design for learning* is generally attributed to David Rose, Anne Meyer, and colleagues at the Center for Applied Special Technology (CAST). However, a fact that is often overlooked is that the principles of UDL were developed following the 1997 reauthorization of the Individuals with Disabilities Education Act (IDEA).

Some readers will recall that during the late 1990s there was considerable interest in the United States in the issue of inclusion. While students with disabilities had gained physical access to the general education classroom, concerns were being raised about how these students would gain access to the "general curriculum." The issues associated with access to the curriculum were at the forefront of CAST's work, and in 1999 federal grant monies were awarded to establish the National Center on Accessing the General Curriculum, which became instrumental in garnering national attention for the potential of UDL.

As CAST's insights about UDL were taking shape, CAST staff presented their work at the annual Office of Special Education (OSEP) Project Directors' conference during the late 1990s. The work was extremely well received by the research community and led to the publication of an interpretive document (Orkwis & McLane, 1998) that was disseminated extensively and served to generate the first wave of national attention to the construct. CAST used additional publication outlets to describe their ideas about how universal design could be applied within education (Meyer & Rose, 2000; Rose & Meyer, 2000).

The second wave of widespread attention to UDL came in 2002, when Rose and Meyer published a book that has become the definitive work on UDL (available from http://www.cast.org/teachingeverystudent/ideas/tes/). They elaborated on the conceptual framework of UDL and how it is grounded in emerging insights about brain development, learning, and digital media. They also pointed to the disconnect between an increasingly diverse student population and a "one-size-fits-all" curriculum, arguing that this would not produce the academic achievement gains expected of 21st-century global citizens. Challenging educators to think of the curriculum as disabled, rather than students, their insights in translating principles of universal design, which originated in architecture, to education are commensurate with advances characterized as a major paradigm shift (Edyburn & Gardner, 2009).

POLICY FOUNDATIONS

In the 2004 reauthorization of the Individuals with Disabilities Education Act (IDEA), the term *universal design* was officially defined within U.S. federal law (20 U.S.C. § 1401) governing special education: "The term *universal design* has the meaning given the term in section 3 of the Assistive Technology Act of 1998" (U.S.C. § 3002).

Following the backward chain of legal reference, the definition of universal design as it was included in the Assistive Technology Act of 1998 is as follows:

> The term "universal design" means a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly usable (without requiring assistive technologies) and products and services that are made usable with assistive technologies. (U.S.C. § 3002)
>
> Next, consider how the terms are defined in the Higher Education Opportunity Act of 2008 (Public Law 110-315, Section 103, a):
>
> (23) UNIVERSAL DESIGN. – The term 'universal design' as the meaning given the term in section 3 of the Assistive Technology Act of 1998. (29 U.S.C. 3002)
>
> (24) UNIVERSAL DESIGN FOR LEARNING. – The term universal design for learning means a scientifically valid framework for guiding educational practice that –
>
> (A) provides flexibility in the ways information is presented, in the ways students respond or demonstrate knowledge and skills, and in the ways students are engaged; and
>
> (B) reduces barriers in instruction, provides appropriate accommodations, supports, and challenges, and maintains high achievement expectations for all students, including students with disabilities and students who are limited English proficient.

Notice how the definition of UD evolved from a concept or philosophy in 1998 to a scientifically validated framework in 2008. Of concern is the fact that to date, there has been little research on UDL although there is a significant body of work on universally designed assessment (e.g., Ketterlin-Geller, 2005; Russell, Hoffman, & Higgins, 2009; Thompson, Johnstone, & Thurlow, 2002). Without an adequate base of primary research, an analysis of research evidence that establishes UDL as a scientifically validated intervention is not possible (Edyburn, in press). Evidently, the work CAST compiled to support various components of UDL design principles (http://www.cast.org/publications/UDLguidelines/index.html) was mischaracterized by lobbyists and written into federal law. The claim that UDL has been scientifically validated through research cannot be substantiated at this time.

DEVELOPMENTAL PERSPECTIVES: THE FIRST 10 YEARS

Within a period of 10 years, UDL has captured the imagination of policy makers, researchers, administrators, and teachers. The mantra that evolved from our understanding of the value of curb cuts and the like, "good design for people with disabilities benefits everyone," provides a powerful rationale for exploring the large-scale application of UDL in education – the lack of a credible research base notwithstanding.

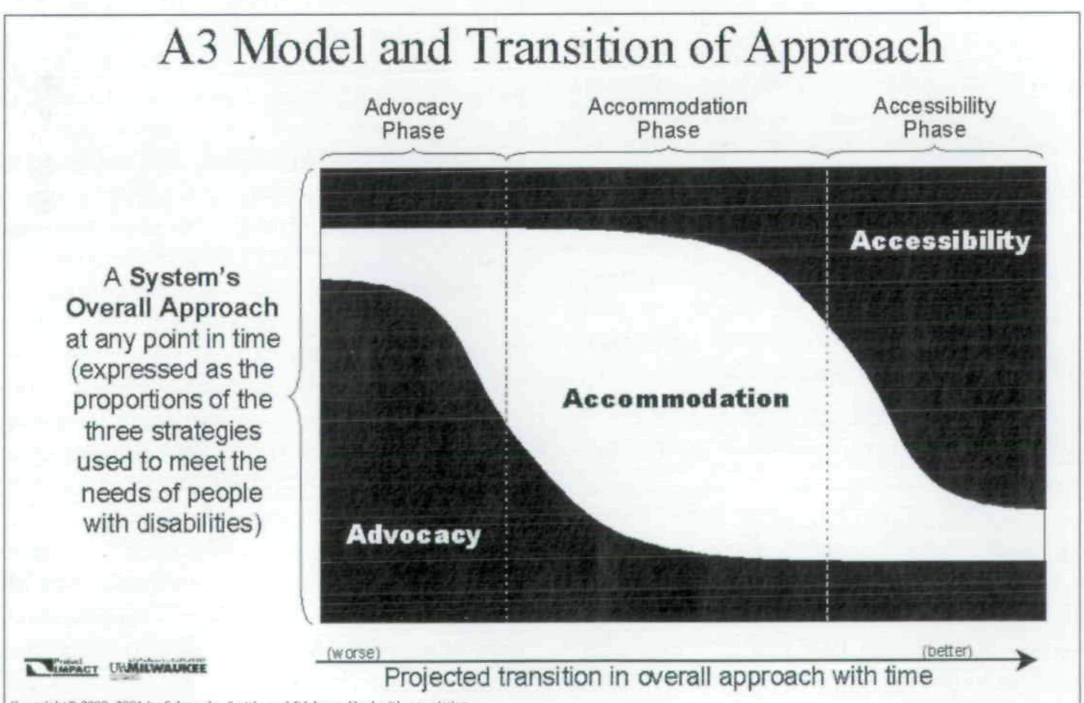
The transition from inaccessible design to universally accessible design will involve awareness training, new technical development, and time. Consequently, the vision of universal accessibility will not be attained quickly. The A3 Model (Schwanke, Smith, & Edyburn, 2001) illustrates the ebb and flow of concurrent interactions between advocacy, accommodation, and accessibility across a three-phase developmental cycle required to achieve universal accessibility (see Figure 1).

Advocacy efforts raise awareness of inequity and highlight the need for system change to respond to the needs of individuals with disabilities. *Accommodations* are the typical response to advocacy. Inaccessible environments and materials are modified and made available. Typically, accommodations are provided upon request. While this represents a significant improvement over situations found in the earlier phase, accommodations tend to maintain inequality since (a) there may be a delay (e.g., time needed to convert a handout from print to Braille); (b) it may require special effort to obtain (e.g., call ahead to schedule); or (c) it may require going to a special location (e.g., the only computer with text enlargement software is in the library). *Accessibility* describes an environment where access is equitably provided to everyone at the same time. Often this is accomplished through outstanding design (e.g., ergonomic furniture, software with accessibility and performance supports built in). All three factors are present in each phase. However, the differential impact of the three components in terms of time, effort, and focus is illustrated by the waves across phases.

The A3 Model illustrates the UDL change process experienced by individuals and organizations. CAST's work on UDL paints a vision of the world in which instructional environments, materials, and strategies are universally designed (as in the Accessibility Phase). They have created an outstanding series of products (i.e., WiggleWorks, 1994; Thinking Reader, 2004; UDL Editions by CAST, 2008; CAST UDL Book Builder, 2009a; CAST Science Writer, 2009b) that provide experiential evidence of what UDL principles could look like in practice.

In the first 10 years of UDL implementation, we have shared the message of UDL with substantial numbers of educators (Advocacy Phase). However, the reality is that once we understand the principles of UDL, we move from Advocacy to Accommodations. This means

Figure 1. The A3 Model illustrates the dynamic nature of advocacy, accommodations, and accessibility in three developmental phases. The differential impact of the three components in terms of time, effort, and focus is illustrated by the waves across phases.



that while we are awaiting widespread availability of the promise of UDL (Accessibility Phase), we are left to our own devices to try to apply the UDL principles to create more accessible accommodations (e.g., "Since the web page does not feature audio, let me show you how to copy the text and paste it into a text to speech tool."). The A3 Model illustrates why many early disciples of UDL find themselves struggling to achieve the potential of UDL within the current limitations of instructional design and product development.

Just as cooperative learning is not defined as whenever two students talk with each other, and co-teaching is not defined as whenever two teachers share the same classroom, we must be able to operationalize the construct of UDL. As UDL is disseminated to broader audiences, I am concerned about the fundamental problem: Will we recognize UDL if we see it? Unfortunately, I have been in many situations where educators, administrators, researchers, or product developers were making claims that their instructional practices are based on UDL principles, but I simply was not able to see the connection.

TEN PROPOSITIONS FOR NEW DIRECTIONS FOR THE SECOND DECADE OF UDL

As UDL enters its second decade, the profession must begin to address some developmental milestones. As every parent knows, the transition from child to adolescent can be turbulent and challenging at times. Similarly, as UDL enters its second decade, I believe it is important to foreshadow some nuances about UDL that have caused minor outbursts in recent years and are likely to explode into typical teenage angst in the years ahead.

In the following analysis, I advance 10 propositions that the profession should consider in order to clearly discern what UDL is and how we might go about implementing the construct with fidelity to properly measure the effects of UDL.

Proposition #1: Universal Design in Education Is Fundamentally Different from Universal Design in the Built Environment.

Observation. As King-Sears (2009) noted, the field of UDL has its genesis in the original construct of universal design as it was developed in architecture. However, in my opinion the seven principles of universal design (Center for Universal Design, 1997) offer little insight into how to design instruction to ensure that diverse learners are successful. For example, the interactions between individuals and the built environment (e.g., stairs, doorways, countertops) are static and limited. In contrast, the interaction between a reader and a text involves complex physical, cognitive, and social interactions to make sense of the information.

New directions. In order to achieve the promise of UDL, I believe the profession must recognize that the essence of UDL lies in the field of instructional design rather than architecture. UDL helps us understand the value of technology for providing access and engagement in learning – prerequisites for learning outcomes. However, much more attention must be devoted to the complex interactions between learning objectives, learner characteristics, performance support strategies, technology, and outcome. Reference to the seven principles of universal design serves only as a distraction.

Proposition #2: UDL Is Fundamentally About Proactively Valuing Diversity.

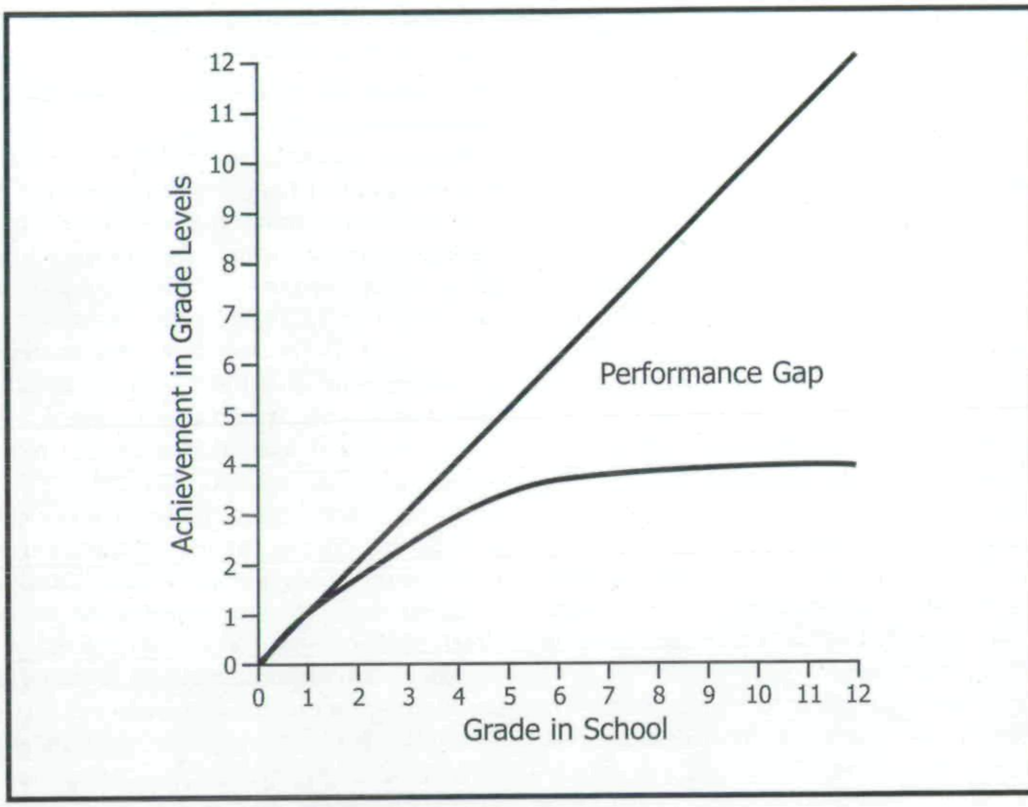
Observation. King-Sears (2009) observed that there is considerable confusion about the roles of technology and UDL. I agree. I have often observed situations where teachers, administrators, and publishers claim they are implementing UDL simply because they are using multimedia or Web 2.0 tools. I disagree. I believe that there must be a priori evidence that the instructional designer understands academic diversity and is proactively building supports that will ensure that individual differences do not mitigate access and engagement. Otherwise, the result is simply a happy coincidence between the use of technology and new tools that students enjoy. UDL is more than simply integrating the latest technology tools into the curriculum.

New directions. I fear that the promise of UDL will not be achieved unless we begin to focus on developing diversity blueprints. I am inspired by the work of several authors (Burke, Hagan, & Grossen, 1998; Coyne, Kameenui, & Simmons, 2004; McLeskey & Waldon, 2007; Tomlinson, 2004) who seek to understand the impact of various instructional designs on the success of diverse learners. Likewise, I am cognizant of research by Molenbroek and de Bruin (2006) that reveals that designers' assumptions about diversity directly impact the accessibility and usability of their product design. That is, when designers assume that everyone is like them (e.g., tall, short, average weight, able to read at grade level), the product they create will meet the needs of a narrow range of users.

Consider the recent fiasco with the Amazon Kindle, where designers failed to recognize that blind readers would want to use a hand-held reading device and that they would need voiced navigational menus – a design decision that was reversed in December 2009 after six months of complaints and disability advocacy (Amazon.com., 2009).

Without a diversity blueprint, it is unlikely that UDL designers will be able to design products that meet the

Figure 2. A representation of the achievement gap illustrates typical development by the diagonal line where students gain one unit of achievement for each year they are in school. Underachievement results in students falling further and further behind and represents a performance gap that is exceedingly difficult to close. Over 50 years of educational research documents the presence of achievement gaps for several groups of students: students with disabilities, students of color, students of poverty, and English language learners.



accessibility and usability needs of all individuals, because they do not understand the special needs of some individuals. Clearly, there is much more to learn about how to meet the instructional needs of diverse individuals. However, until we begin describing the salient nature of those differences in ways that inform design, it is unlikely that we will design products that meet the needs of all learners.

Proposition #3: UDL Is Ultimately About Design.

Observation. UDL is about design. Design is fundamentally about problem solving. Instructional design is about the efficacy of learning. Central to all of these constructs is evidence of intentionality and how problems can be resolved through innovative design. Technology is simply the delivery system.

New directions. A fundamental question that has yet to be addressed is whether or not the demands of daily instruction will allow teachers to function effectively as instructional designers. That is, are teachers the principal stakeholders as they design and deliver instruction in accordance with UDL principles? Or, is UDL a task for developers who make instructional products?

Given the difficulties I have observed in trying to scale UDL implementation beyond single classrooms, I believe it may be necessary to rethink UDL as a product development intervention. Perhaps the teacher's role is more appropriately associated with implementing principles of differentiated instruction (which may include some products that have been universally designed).

Proposition #4: Universal Design for Learning Is Not Just Good Teaching.

Observation. Another means of understanding UDL is to clarify what it is not. Unfortunately, statements like the following are found in the literature: "universal design for learning is just good teaching" or "it is like what you have always done" (Castellani, Mason, & Orkwis, 2005; Orkwis & McLane, 1998).

I believe these statements reflect a fundamental misunderstanding of the functions of design, proactively valuing diversity, and intentionality. What we have always done is known as the achievement gap (see Figure 2). Educational research illustrates that marginalized students such as students with disabilities, culturally and linguistically diverse students, students from low socio-economic backgrounds, and English language learners experience chronic school failure; hence the focus on calculating adequate yearly progress (AYP) within the No Child Left Behind legislation. This pattern of performance is not evidence that existing instructional practices are effective for all students.

New directions. UDL represents a 21st-century intervention that seeks to use emerging insights gained from research in diverse fields such as brain imaging, learning sciences, instructional design, and technology. Good teaching has never been able to address the full range of diversity found in a classroom.

To allow this type of language to continue in UDL discussions renders the construct meaningless. More important, statements such as "UDL is just good teaching" serve to preserve the status quo, which marginalizes low-performing students. We must find ways to define and measure implementation of UDL in order to discern when it is being implemented and when it is not.

Proposition #5: Universal Design for Learning Does Not Occur Naturally.

Observation. On more than one occasion, I have heard the statement, "Many teachers are already doing UDL; they just don't know that's what it is called." This is a corollary to the previous proposition. Since UDL is the convergence of multiple disciplines, I reject the notion that there is a natural trait within effective teachers that allows them to implement UDL without knowing that they are doing so. I do not believe that UDL occurs naturally. In some respects, this issue may simply be a permutation of the timeless argument about whether teaching is an art or a science (Dewey, 1929; Gage, 1978; Skinner, 1954).

New directions. Much like any other integrative cognitive skill, UDL must be recognized as a learned skill, one that is refined over time, to produce high levels of performance. One way of advancing this issue would be to host a national design competition where contestants were challenged to solve an instructional problem by creating an innovative universally designed instructional product. It may also be appropriately to design studies to empirically test this proposition. We must refocus our efforts to train the key stakeholders in UDL principles that make meaningful differences in student engagement and learning.

Proposition #6: Technology Is Essential for Implementing UDL.

Observation. King-Sears (2009) addresses the issue of whether or not UDL can be implemented without technology. Others have suggested that UDL is just like assistive technology, such that it can be implemented as no-tech, low-tech, or high-tech. I reject these notions. The reason why UDL is possible today as opposed to the 1950s or 1970s is that digital technology provides a high degree of flexibility. Paper-based instructional technologies (e.g., worksheets, textbooks) commit information to fixed formats and cannot match the array and flexibility of supports provided in a digital environment (e.g., alter the font size, color contrast, text to speech, hyperlinks for explanatory aids, agents that offer strategy suggestions, movies that supplement text). An example of this point is the subject of a recent YouTube video where a high schooler struggles to navigate his traditional textbook since it fails to provide the digital supports he is grown accustom to (Joe's Non-Netbook; http://www.youtube.com/watch?v=skhpm EZWuRQ).

New directions. Why is computer technology essential for a majority of 21st-century activities outside of school but optional for helping students achieve high standards within school? When will a computer be considered essential for all students so that they can access and engage in a curriculum that is appropriate for their learning needs? To suggest that the potential of UDL can be achieved without technology is simply another way to maintain the status quo. Fortunately, the current price trends for Netbooks (they are becoming more and more affordable) may render this discussion moot within a few years.

Proposition #7: UDL Is Not Assistive Technology.

Observation. The relationship between UDL and assistive technology has been a point of confusion for many educators (Rose, Hasselbring, Stahl, & Zabala, 2005). If, for example, a building has an electronic door sensor to open the front door automatically, is it reasonable to conclude that wheelchairs will no longer be needed? Assistive technology devices and services are delivered reactively after a referral and evaluation of an individual student. UDL is given to everyone with the understanding that those who need specialized support will use the tools when they need them (i.e., embedded, just-in-time supports).

This is a critical paradigm shift that fully acknowledges the impact of peer pressure at the middle and secondary level. To meet the needs of some, UDL is committed to giving the tools to everyone. Assistive technology may be pre-empted by UDL interventions; however, as the example above illustrates, assistive technology and UDL may also co-exist.

New directions. Academic performance problems are not limited to students with disabilities. Therefore, why should technologies that enhance academic performance be restricted to students with disabilities? When new information is introduced in schools, learners perform as novices; that is, their performance is significantly different than that of experts. However, with proper instruction, the performance of a novice can be enhanced to very high levels. Additional research and development is needed in the area of cognitive prostheses (Edyburn, 2006) in order to clarify the benefit of tools and strategies that serve as scaffolds (temporarily needed and discarded) vs. tools that augment performance (always needed for acceptable performance).

Twenty-first-century instruction will likely need to alter instructional practices in order to place students in the role of Goldilocks – they try multiple options to determine which option is "just right" for ensuring their performance is acceptable to meet high standards. Principles of fairness indicate that equity is achieved when every student receives what he or she needs (Welch, 2000).

Proposition #8: It Is Necessary to Measure the Primary and Secondary Impact of UDL.

Observation. As King-Sears (2009) pointed out, one of the promises of UDL is that by focusing on the special needs of students with disabilities we can design solutions that positively impact other students. This principle can be illustrated by the example of the zero-entry swimming pool. The original design problem focused on how to enable people in wheelchairs to enter a pool. Clearly, the needs of the primary audience have been effectively met through this design. If the design innovation only helps a disability group, the intervention is simply an assistive technology. When the secondary impact of the zero-entry pool is examined, we observe that the majority of the users of the shallow end of the pool are parents with young children, teenagers, and senior citizens. This phenomenon illustrates an innovative tactic for quantifying and evaluating UDL claims by measuring and analyzing primary and secondary impact.

In contrast, when word prediction software is given to everyone, it is not a tool that continues to be used by everyone because it often interferes with the keyboarding performance of accomplished writers and typists. Consequently, it must be considered assistive technology, rather than UDL.

New directions. Instructional designers need to explicitly describe the intended user of a product. When the product is implemented within schools, appropriate research methodologies must measure the impact of the intervention on the primary audience as well as the rest of the students in an inclusive classroom. Data analysis should focus on discerning whether or not the product successfully produced the desired gains in the targeted audience. Secondary analysis should examine whether there were additional effects within the inclusive classroom such as are observed with the zero-entry swimming pool or whether the effects were more like word prediction software that offered benefits only to a small group. Further development of research analyses of the primary and secondary effect of UDL is essential for fostering a new generation of data-based discussions about UDL efficacy.

Proposition #9: Claims of UDL Must Be Evaluated on the Basis of Enhanced Student Performance.

Observation. One of the significant flaws in a federal law (Higher Education Opportunity Act of 2008) that states that UDL is a scientifically validated framework is that CAST's UDL framework does not feature a component associated with the measurement of student learning outcomes. All three of the "multiple means" statements by CAST focus on providing multiple concurrent interventions. As a result, within existing conceptualizations of UDL, there is no clear way to measure claims that UDL is effective for enhancing the academic performance of diverse students. This is a significant shortcoming for anyone trying to operationalize, implement, and evaluate a UDL program.

New directions. If UDL is nothing more than providing students with alternatives, it fails significantly as a new paradigm for enhancing educational achievement, as it is simply another futile attempt to argue that schools needs more resources. I choose to believe the critical focus of UDL is its emphasis on the variables that can be manipulated to produce high performance. I am inspired by Tomlinson's (1999) conceptual work on the design of equalizers that could be utilized to manipulate key instructional variables to make curriculum accessible and engaging.

Research has demonstrated a relationship between deep learning and high levels of performance and expertise (Csikszentmihalyi, 1990; Schlechty, 2002). UDL outcome measurement needs to focus on the benefits that result from access and sustained engagement: Expertise and expert performance. That is, sustained engagement in learning tasks, of increasing difficulty and complexity, leads to high levels of learning and performance. The notion of applying a computer interface to a digital body of knowledge and then allowing the student to manipulate the information in ways that make it accessible (i.e., physical, sensory, and cognitive), at a level of appropriate challenge, has everything to do with the process of developing expertise. Ultimately, we need to understand how to measure the contributions of UDL to sustained engagement and development of expertise.

Proposition #10: UDL Is Much More Complex Than We Originally Thought.

Observation. Understanding the potential of UDL is seductively easy. Its exponential growth indicates that it is the right idea at the right time. However, it has proven far easier to help the various stakeholders understand the potential of UDL than it has been to implement UDL on a large scale. And now that more people are "doing UDL," it is not clear what the outcomes are.

New directions. As we head into the second decade of "doing UDL," it is time for a new generation of thinking about UDL. Defining UDL as a subfield within instructional design will provide a knowledge base that is more relevant than looking to architecture for insight. Likewise, we must become serious about defining the key variables that impact instructional achievement and develop algorithms and tools that modularize the design process so we can develop more UDL materials more quickly and more cost effectively. We need to clarify the core stakeholders (developers or teachers) who will be trained to create UDL products. We need to understand what it means to implement UDL. We need to understand how to measure the outcomes of UDL. And, finally, we need to renew our commitment to equitably serving all students in the event that our UDL efforts fall short.

CONCLUDING THOUGHTS

As UDL is aligned with response-to-intervention initiatives, it is important for the learning disability community to engage in dialogue about the principles and practices of UDL. Without a doubt, UDL holds considerable promise. In this article I have offered an analysis of the developmental progress of UDL and described 10 propositions that need to be addressed as we go forward. Unless serious intellectual energy is devoted to addressing the current shortcomings of the UDL construct, within the next 10 years we may be commemorating the passing of another education fad.

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Please address correspondence about this article to: Dave Edyburn, Department of Exceptional Education, University of Wisconsin-Milwaukee, 3409 North Downer Avenue, Milwaukee, WI 53211; e-mail: edyburn@csd.uwm.edu

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PUTTING UNIVERSAL DESIGN FOR LEARNING ON THE HIGHER ED AGENDA

KATHLEEN GRADEL, Ed.D.
SUNY Fredonia

ALDEN J. EDSON, B.S., Mathematics Ed.; B.S., Mathematics
Western Michigan University

ABSTRACT

This article provides an overview of how Universal Design for Learning (UDL) applies to higher education. Illustrations of UDL implementation are made, using both campus models of systemic change and coursework exemplars. Start-up solutions and sample applications are summarized. The purposes of this article are to: provide an overview of UDL, including needs for and challenges to UDL in higher education; and identify start-up strategies and models for faculty implementation of UDL practices, addressing potential challenges to their use.

Universal Design for Learning (UDL) stems from the "universal design" (UD) movement. UD was initiated to embed accessibility features in buildings during design and construction, rather than making expensive retrofitted products to meet the growing needs of diverse populations (Mace, 1985; Rose, 2000). For example, Mace (1985) described how the original design of curb cuts in sidewalks—as well as alternative entry ramps and easy-access doors—increased accessibility of physical space to wheelchairs. Curb cuts and alternate doors inadvertently extended access from people with disabilities to uses by a range of diverse users (e.g., shopping carts, strollers, skateboards, and bicycles). Not only did these new features make physical spaces more user-friendly, but the new

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designs were more functional, visually appealing, and economically sound than retrofitted buildings (Rose, 2000).

Instead of working with the physical environment, UDL-smart educators "flex" the instructional environment using multiple goals, methods, tasks, materials, and assessments to meet students' needs. Rose and Meyer (2002) define UDL as follows:

> The key to helping all students achieve is identifying and removing barriers from our teaching methods and curriculum materials. Drawing from brain research and using new media, the UDL framework proposes that educators strive for three kinds of flexibility:
> - To represent information in multiple formats and media.
> - To provide multiple pathways for students' action and expression.
> - To provide multiple ways to engage students' interest and motivation (p. 69).

The key to the UDL framework is providing multiple means of representation, multiple means of expression, and multiple modes of engagement (Rose, 2000). UDL features embedded in learning tasks, materials, and learning goals can help students with disabilities, while benefiting those without identified disabilities. UDL uses technology as the basis of many of these potential strategies, to make education more inclusive.

The purposes of this article are to:

- provide an overview of UDL, including needs for and challenges to UDL in higher education; and
- identify start-up strategies and models for faculty implementation of UDL practices, addressing potential challenges to their use.

WHAT IS UDL'S RELEVANCE IN HIGHER EDUCATION?

On today's higher education campuses, the mix of students is increasingly diverse. Course seats are likely to be filled by students who face any one of many possible learning challenges, including learning disabilities, English language barriers, emotional challenges, low motivation/engagement, physical disabilities, and sensory disabilities. The enrollment of full-time college freshman with disabilities increased from 2.3% to 9.8% over the past 20 years (Henderson, 1999). Of students identified as "at risk," 75% continued from secondary to post-secondary education (Hayward, 2000; Horn & Berktold, 1999). Students range from adolescents to second-career professionals; 39.5% are 25 or older. Further, students have an increasingly diverse courseload; for example, 43% attend part-time (Hayward, 2000).

Post-secondary students arrive on campus with a broad range of skills in managing their own learning and study (Bowe, 2000; Gradel & Edson, 2009b). Consider the student prototypic "challenge sets" summarized in Table 1. Do

Table 1. Learning Challenge "Prototypes"

Reading difficulties	Writing difficulties	Researching difficulties
• Connecting back-ground knowledge to new concepts. • With some reading skills, especially in new content. • With reading fluency. • Comprehension skills. • Mastering new vocabulary. • Retention of what has been read.	• Identifying core ideas/ research topics. • Linking ideas to prior knowledge and new concepts. • Applying new concepts to examples and new reading. • Organizing ideas and/or writing. • Drafting. • Using feedback con-structively to make revisions. • Time and energy use. • Producing clean, clear well-written final work products.	• Planning projects • Selecting research topics. • Identifying related sub-topics. • Identifying search constructs. • Using strategies and tools for efficiently gathering information. • Organizing information that has been collected. • Combining components into the final product. • Timelining work to complete a final finished product on time.

these learner challenges coincide with the profiles of students who have recently been enrolled in your courses? Higher ed faculty must expect, prepare for, and work with students' academic diversity—both their strengths and their needs. Higher ed faculty and staff who are committed to their students' success know that a singular approach to teaching does not work. UDL is an approach that helps educators respond to student learning challenges in their classrooms and courses.

UDL HIGHER EDUCATION IMPLEMENTATION MODELS

What are the challenges to implementation? Gradel and Edson (2009a, 2009b) summarized seven overarching challenges to even small-scale transition from traditional higher ed instruction to integrating UDL practices:

- differing visions of expectations, process, and outcomes;
- time and competing contingencies needed to "gear up," implement, and maintain new practices;
- staff/faculty turnover;
- identifying and coordinating the roles/responsibilities of faculty, students, and support staff;
- technology fears and learning curves, for both students and faculty;
- adequacy of campus dissemination/training vehicles; and
- resource access and exchange.

There has been limited implementation of UDL in higher education (Bowe, 2000), but there are several implementation models that are operational and that have made many of their resources widely available. Many have had their origins in campus Offices of Disability Services; others have grown from all-purpose "student affairs" offices. Table 2 lists several universities and colleges that have reported viable UDL implementation models.

Implementation steps to making systemic change in higher ed coursework have been documented most recently and comprehensively by Sonoma State College, as the EnACT Project has worked with faculty across the California State University system to operationalize UDL practices. These implementation steps have resulted in demonstrable change in faculty practice. EnACT (2009) has recently completed a study of 456 undergraduate and graduate students (with and without disabilities). EnACT's recent survey data indicate that the following course components were the most essential to student learning: (a) informative and clear course syllabi; (b) multiple teaching styles and modes to convey course concepts; (c) offering pedagogical practices for students to engage and respond by giving feedback; and (d) differing and thorough guidelines for course assignments.

UDL IN HIGHER ED COURSEWORK

The key to much of this work is leveraging the power of digital text. With the significant change in both availability of digital text and Web 2.0 tools (Solomon & Shrum, 2007), UDL has gotten a major boost (Gradel & Edson, 2009a, 2009b). Conversion of assignments to maximize the UDL "multiples" principles has become increasingly easier, with the burgeoning pool of available tools that extend electronic curb cuts to all users. To illustrate UDL in action, this section summarizes components of two sample assignments, comparing them to parallel, traditional assignments.

Table 3 provides a comparison of a traditional vs. a UDL-enhanced research project. The traditional version is a familiar variation on a common research and writing theme. The UDL-enhanced version maximizes using both online supports and a collaborative culture to build research competence and publishing skills.

Table 2. Campuses with a History of—and Resources Available for—Implementing UDL Practices

Institution	URL
Colorado State University	http://accessproject.colostate.edu/
Emory University	http://www.portals.emory.edu/sylideas.html
Johnson State College	http://www.jsc.edu/Academics/AcademicSupport/ForFaculty/TeachingStrategiesUniversalDesignforInstruction.aspx
Ohio State University	http://telr.osu.edu/resources/links.htm
North Carolina State University	http://www.udeducation.org/about/index.asp
San Francisco State University	http://ctfd.sfsu.edu/accessibility-resources.htm
Sonoma State University	http://enact.sonoma.edu/udl
Springfield Technical Community College	http://www.stcc.edu/ods/doe/nsf_faculty.htm
University of Connecticut	http://www.facultyware.uconn.edu/home.cfm
University of Guelph	http://www.tss.uoguelph.c/uid/
University of Maine	http://www.ccids.umaine.edu/projects/ee-udl/default.htm
University of Washington	http://www.washington.edu/doit/Resources/udesign.html

Further, using readily available technology, multiple formats of information sources become part of the students' reference pool. Finally, the assignment capitalizes on media to convert students' research into a final product that has potential authenticity, namely a podcast designed for use by others.

Table 4 illustrates the use of concept mapping—coupled with traditional note taking—to build and apply connections to background knowledge and to recently-learned material. It capitalizes on interdependent meaning-making, as well as on building a common classwide knowledge base through joint publishing.

Table 3. Comparison of Traditional vs. UDL-Enhanced Research Project

Traditional	UDL-enhanced
Goal: Research, compile, self-edit, and present a cohesive research compilation on evidence-based educational practices.	
• Research topic.	• Identify a research agenda and timeline the project, using an online agenda/timeliner.
• Compile a well-written correctly formatted document.	• Research topic, providing evidence of the credibility of sources by incorporating hypertext links and information on the sources. Secure needed supports through various online research aids (e.g., Assignment Calculator @ http:///www.lib.umn.edu/help/calculator/; Noodle Tools Search Starter @ http://www.noodletools.com/debbie/literacies/information/5locate/adviceengine.html)
• Submit document to instructor for grading.	• Incorporate input on the topic from at least one expert, via (a) archived interview information; (b) podcast; (c) webinar; and/or (d) Skype interview.
• Present findings to class orally or via a PPT presentation.	• Compile a well-written, correctly formatted document. Post the report to the course Wiki, embedding links to primary sources and examples.
	• Host a discussion by peers on the paper, using the “discussion forum” on the Wiki.
	• Incorporate comments by peers into a self-review of the document, before submitting for grading.
	• Generate a podcast of the key ideas in the research, as one episode of the class’ online podcast series on evidence-based educational practices.

Table 4. Comparison of Traditional vs. UDL-Enhanced Note Taking

Traditional	UDL-enhanced
Goal: Take notes on readings, incorporating connections to background knowledge and recently-learned material; apply concepts.	
• Read assigned material • Take notes. • Review notes while participating in class discussion. • Maintain notes, for future use in course assignments and assessments.	• Read assigned material. • Using your text, record key/big ideas, along with the location in your text where you found the information. • Building a graphic organizer that captures the big ideas that you recorded from your reading, using one of these online concept mapping tools: Mindmeister: http://www.mindmeister.com/; Bubbl.US: http://www.bubbl.us/; Mind42: http://www.mind42.com/. Mindomo: http://www.mindomo.com/ • Post your graphic organizer to the course Wiki. • Now browse others' postings. Invite a colleague to review your concept map, and to collaborate with you on building an example of one of the big ideas in your map. You will also work with him/her on his/her map, doing an example that fits. • Let's look at some video cases in class, and "test" our ideas about what we read and how we understand the concepts. Be sure to bring a hard copy of your final maps and examples, if you don't have your laptop in class.

Starting points for "novice" UDL implementers can be manageable. Table 5 summarizes several feasible start-up strategies with an emphasis on multiple forms of representation and expression. Table 6 suggests start-up UDL-based strategies that focus on managing instructional pedagogy to optimize multiple forms of student engagement.

Table 5. Start-Up Representation/Expression Strategies
Stretch UDL Practices

- Model, use, and ask students to use multiple formats (say it, show it, write it).
- Prep/post materials in multiple formats (hard copy; digital, posted to course management or other web venues; reviewed).
- Prep digital materials for ease of use; build hyperlinks to supports (e.g., startup research points, sample work, online tools).
- Design course outcomes that cross "learning styles" (i.e., not all paper-pencil products).
- Give some (limited) choices about product formats (multimedia, presentations, traditional written work).
- Use digital text to the max; help and expect students to use online tools to access text, text extensions (e.g., links to additional resource), and online supports (e.g., search, read aloud).
- Maintain a "tech tools" or "support toolbox" folder posted on your course management system, including, for example:
  - How to use the autosummary tool in Word, to pre-read/get big ideas from digital materials.
  - How to use effective online search strategies and have a smart online presence (e.g., http://novemberlearning.com/)
  - Tools for scaffolding student research (e.g., NoodleTools @ http://www.noodletools.com/index.php; The Assignment Calculator @ http://www.lib.umn.edu/help/calculator/)
- Use and ask students to use online (and offline) conceptual mapping tools (e.g., http://www.mindmeister.com/, http://www.minomo.com/, http://www.bubbl.us/, or http://www.mind42.com/

Table 6. Start-Up Engagement Strategies to Stretch UDL Practices

- Use frequent, quick ways to assess where students are—and where course corrections may be necessary. For example, try variations of the “muddiest point” card that students complete at the end of class and submit; note that this can be done online on a Blog or on a Wiki, as well.

- Build in work that students complete, self- or peer-correct with guidance in class, then submit.

- Find/build/use a core course rubric for both the instructor and students to frequently rate products, participation, effort, understanding.

- Incorporate “smart” cooperative learning strategies (not “plain old” group work), attending to student interdependence AND independence.

- Shorten lecture time, replacing that time with more “minds-on” application work in class. Remember . . . more active learning/response opportunities produce greater achievement (regardless of age, learning setting).

- Ask students to create notes for the class (or sub-groups of the class) to use (vs. instructor-built guided notes); or ask them to extend the summaries often available through online supports from text publishers. Ensure that they post digitally (e.g., on a blog or Wiki).

- Experiment with online tools and venues that “push” students (and faculty) to dialogue/use effective linking, to “connect” learning, converse asynchronously, and hone 21st century skills; for example, use a Wiki, asking students to “own” chunks of it, and do various tasks on it.

- Use learning sequences that help students move through Bloom’s taxonomy (http://www.stedwards.edu/cte/resources), from knowledge to application to generalization. For example, students can build core knowledge into a graphic organizer, then ask them to apply to cases.

- Build student “safety nets”; for example, ask students to share contact information, to be available for mutual help out of course sessions.

- Build student interdependence; try the “Ask 3” strategy (“ask 3 people” before the processor). Or use a “Got Questions?” strategy to check for understanding; e.g., ask students to meet in small groups to generate a question; then groups toss their questions from group to group . . . the next group gets to ask a question if they take a tackle a question from another group.

SUMMARY

Faculty are responsible for identifying and managing potential barriers in teaching/learning materials, instructional sequences, teaching methods, and how student learning is assessed. Optimally, course instructors should also be aware of—and encourage—the interface of students with collateral campus supports; for example, if tutoring or writing supports are available, referring students with needs in these areas is a logical instructor function.

The bottom line is that both faculty and non-teaching staff (e.g., librarians) must extend beyond the practices and expectations from "the good old days" to a more inclusive notion of teaching and learning. Part of this changing mission is a necessary commitment to stretching students' ownership of their own learning experience. Planful, "do-able" adjustments in pedagogy and the use of technology tools will produce positive UDL-based impacts on student learning and access. UDL is a "friendly reminder" of how faculty and staff in higher ed can be even more "with it" as facilitators of learning (Gradel & Edson, 2009a, 2009b).

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Direct reprint requests to:

Dr. Kathleen Gradel
Thompson Hall E276, SUNY Fredonia
Fredonia, NY 14063
e-mail: kathleen.gradel@fredonia.edu

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A Dance with the Butterflies: A Metamorphosis of Teaching and Learning Through Technology

Sarah McPherson

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Abstract This paper describes a web-based collaborative project called *A Dance with the Butterflies* that applied the brain-based research of the Center for Applied Special Technologies (CAST) and principles of Universal Design for Learning (UDL) to Pre-K-4 science curriculum. Learning experiences were designed for students to invoke the Recognition, Strategic, and Affective neural networks for learning identified in the CAST research. Instruction was based on the Science Education content standard that all students should develop an understanding of the characteristics, life cycles, and environments of living organisms. Teachers designed interdisciplinary projects for students with the metamorphosis of the butterfly as the theme the unit. Participants from nine states and four countries learned about UDL to transform teaching and to collaborate through a blog that supported their learning. They shared new technology applications for use in their projects. The learning that occurred and the excitement to use technology for learning clearly demonstrate the power of the UDL framework for increasing engagement and understanding by all learners.

Keywords Universal design for learning · Technology · Collaborative projects · International exchange · Elementary science education · Life cycle · Performance-based · Inquiry-based · Constructivism

S. McPherson (✉)
New York Institute of Technology, New York, NY, USA
e-mail: smcphers@nyit.edu

Just as the life cycle of the butterfly begins as a tiny egg, the idea for this online collaborative project began in a conversation with a colleague, Susan Silverman, who has vast experience in facilitating collaborative projects. The conversation resulted in the birth of *A Dance with the Butterflies*, an online collaborative project for young children to explore the life cycle of the butterfly using Universal Design for Learning (UDL) as an instructional framework. A project website, http://kids-learn.org/butterflies/, inviting participants from Susan's network was launched (Fig. 1).

Response came from teachers in nine states, Canada, South Africa and Hong Kong. Grades taught ranged from Pre-K through 3rd grade (Table 1).

The Project Information section of the website laid out the basic concepts of the butterfly metamorphosis process and the framework of UDL. The 'egg' of an idea was nurtured by the enthusiasm of the participants to the larva phase with nourishment from the resources the website and the collaboration through the blog (http://butterflydanceproject.blogspot.com/). The cocoon phase was the work of the teachers and students to develop the concepts to produce their evidence of learning in projects and performances. The butterflies emerged in the Student Showcase of projects demonstrating their learning, creativity and enthusiasm for learning. The initial instructional planning phase guided teacher participants through an analysis of their traditional approaches and the characteristics of their students.

Instructional Planning

Given the fact that children learn in different ways, a 'one size fits all' instructional approach presents barriers to learning for some children. When planning instruction

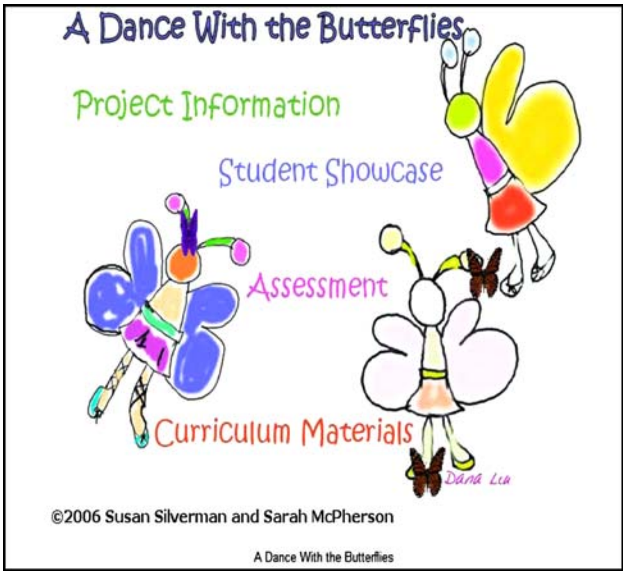

Fig. 1 *A Dance with the Butterflies* project web site. http://kids-learn.org/butterflies/

Table 1 Teacher participant grade level taught and country, state or province of school

Grade level	Country/State or Province
Pre-kindergarten	USA/New Jersey
Kindergarten	USA/Connecticut, Illinois
Grade 1	USA/New Jersey
Grades 1 & 2	Canada/British Columbia
Grade 2	USA/Massachusetts, Ohio, Wisconsin, South Carolina, Canada/Ontario
Grade 3	USA/California, South Africa/Cape Town, Hong Kong

it is imperative to consider these barriers as they relate to accessibility to the curriculum (Hall et al. 2003). Often barriers to learning are the result of our reliance on text-based instructional materials. If a child has difficulty with language—due to lack of vocabulary and reading skills, visual impairments, English as a second language, or learning disability—then a text-based curriculum and instruction present significant barriers to learning. Other barriers may be a child's limited opportunities to participate in learning activities due to lack of interpersonal social skills to work in groups or personal self-direction conducive to active learning. Some children simply lack interest, motivation and enthusiasm for learning (Rose and Meyer 2002). According to the researchers at the Center for Applied Special Technologies (CAST), these barriers to learning may be overcome if instruction is planned to address the appropriate interrelated neurological networks of the brain. Instruction should be designed so that all students can participate in the learning at their own level doing what interests them most (Downs et al. 2005). Teachers participating in the butterfly project reported that their awareness of potential barriers to learning informed their planning for use of UDL to increase participation and learning. In one teacher participant's observation she shares, "One girl in my class has sat quietly all year and occasionally raised her hand to answer a question. With this assignment, she has come up to me several times to ask questions about her project and to show me what she has learned. It has been amazing to me to see the interest she has shown. I have definitely decided that UDL is the way to go!"

What is UDL?

Universal Design for Learning is a framework developed by researchers at the Center for Applied Special Technology (CAST) based on brain-based research for universal accessibility for all students. The research is grounded in special education under the premise that all children can learn if instruction is designed to trigger the neurological networks that control the learning process. These networks are defined as follows:

- Recognition networks receive and analyze information (the *what* of learning);
- Strategic networks plan and execute actions (the *how* of learning);
- Affective goals evaluate priorities (the *why* of learning). (Rose and Meyer 2002, p. 11).

The UDL curriculum design principles call for increased flexibility in presentation, expression and engagement to accommodate student learning (Rose and Meyer 2002). CAST suggests technology as a way to provide the flexibility for teaching every student. Technology was a huge part of the butterfly project. The Project Information on the *Dance with the Butterflies* website provided teacher participants with examples to illustrate the multiple formats and types of media that could be used to provide the flexibility for UDL lessons. Links to websites with pictures, diagrams, videos, and audio clips were used in the explanation and in the Curriculum Materials section of the project website. These resources contained information about UDL, special technologies, and content pertaining to butterflies.

A focus of applied special technologies at CAST is text-to-speech programs designed for students who are blind or visually impaired and those with dyslexia (Rose and Meyer 2002). Text-to-speech programs support language development in young readers reinforcing the association between written and spoken word. A Microsoft Agent called Peedy was used on the project web site to demonstrate how text-to-speech works. One participant reported "I had never even met Peedy before this project! Now when my kids dictate their words to me… they request that Peedy read it back to them! They are making the connection between the written and spoken word in a way that I had never even imagined". Another participant said, "The text-to-speech was helpful for students who needed this extra support while reading their classmates' pages. Others turned it on just because they thought it was fun to watch a parrot read the pages!"

The neurological networks for learning are important for planning instruction so that it is accessible to all learners. Educators need to understand these networks and how their functions can be a framework for curriculum and instruction for *what*, *how* and *why* learning happens. Let's begin with the *what* of learning.

Recognition Networks

Recognition networks give meaning and understanding to information, ideas and concepts (Rose and Meyer 2002, p. 12). To interpret information we must be able to identify patterns and unique characteristics through our senses and written and spoken language. The recognition network functions are distributed for multiple simultaneous ways to intake information that contributes to interpretation and understanding. To facilitate learning, the brain synthesizes information hierarchically using clues from background knowledge, context, patterns, unique characteristics, and sensory input. The processing that occurs in the brain to synthesize information varies among individuals. Teacher participants in this project gained a new perspective on ways to individualize instruction to maximize opportunities to learn. Directions were given to pay particular attention to the goals of the instructional planning and to provide multiple examples of the concepts of the life cycle, highlighting critical features of the concepts while using multiple media types and formats, contexts and background knowledge. Hotlinks were posted in the Project Information section to illustrate the idea of multiple representations using video streaming, pictures, photos, diagrams, and online reference materials.

Teacher participants were very creative in finding their own multimedia resources to support recognition networks. They used QuickTime Movies™ to introduce the life cycle of the butterfly, books for shared reading, multiple pictures of various species, websites with maps for various habitats, and even information they found from other countries and in other languages. Reading comprehension activities for vocabulary development, sequencing and making predictions activated the recognition networks. Text-to-speech and audio resources were used to support language development for non-readers and English language learners to develop their understanding of the concepts. More advanced reading materials were provided for the more fluent readers, useful for differentiating instruction and providing appropriate challenge for students who need it. Several participants used live butterfly kits and planted butterfly gardens for authentic hands-on learning experiences through observation of the metamorphosis process. Others took field trips to the zoo with digital cameras to capture the stages of the life cycle of other animals compared to that of the butterfly. A participant named Miss Hope sums up her quest for resources to get started on the project in these words, "Spring has sprung around here! My group of 3's and 4's are breaking ground in preparation for a new butterfly habitat in that area of our schoolyard. I have ordered Monarch Butterfly Life Cycle kits and Painted Lady kits and I've been gathering photographs, software, videos, web sites, and a host of materials for all of our indoor and outdoor learning centers".

The materials and technology provided flexible means of representation for invoking the recognition networks; the plans for engagement in active learning supported the strategic networks for developing understanding—the *how* of learning.

Strategic Networks

Strategic networks in the brain control the mental and motor action required for thinking and acting strategically. Brain research indicates that complex strategies for critical thinking, decision-making, organization and self-monitoring are accomplished by the strategic networks of the frontal lobe (Rose and Meyer 2002, p. 23). Multiple activities for students to practice the concepts for learning support the strategic networks (Hitchcock et al. 2002). Focus on strategic aspects of instruction provide students ways to learn by giving them ample and varied opportunities for practice, ongoing support, relevant feedback, and multiple ways to express their learning. Teacher participants used a variety of technology tools with students to be creative in their learning. The most common was MS PowerPoint with students' drawings and writings imported into the slide show. Students from Hong Kong used Audacity and Click Caster to introduce their interactive PowerPoint game (see Fig. 2). The multiple types and formats of media uses illustrate ways to apply UDL in instruction.

Project learning activities were designed to support the strategic networks using content standards to guide the instruction and UDL in assessment to monitor student content knowledge and vocabulary skills. Focus on strategic networks is crucial for designing instructional strategies for effective and engaging active learning.

Fig. 2 Interactive PowerPoint game of *A Butterfly Egg* with podcast introductions

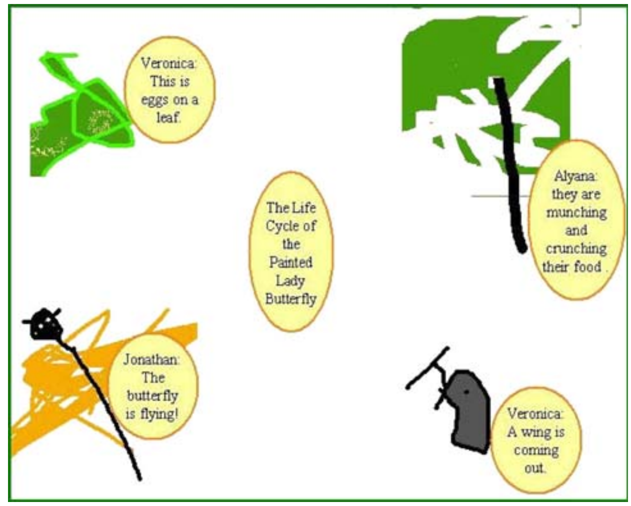

Fig. 3 Students' collaborative representation of life cycle

Instructional Strategies

Content standards in interdisciplinary instructional projects were woven into the instructional strategies. Science curriculum standards were the starting point for the instruction. Science Education Life Science Content Standard C states, "As a result of activities in grades K-4, all students should develop understanding of the characteristics of organisms, life cycles of organisms, organisms and environments" (National Committee on Science Education Standards and Assessment 1996, p. 127). Primary science curriculum addresses the life cycle and reproductive systems of animals and plants, their natural habitats and needs for food, water, air, light, and shelter, and classification of species based on their unique characteristics. The butterfly project focused on these foundations to basic life sciences at the primary early grade level. Students learned the stages in the butterfly's life cycle, the habitat, migration patterns, and requirements for sustenance through a myriad of instructional formats: descriptions of metamorphosis and the life cycle, functions of body parts and sensory interaction with the environment in writing, illustrations, drama and music; applications of critical thinking comparing and contrasting the life cycle of the butterfly with other species; classification based on characteristics; habitats for basic needs to sustain life (food, water, air, light, shelter); and science equipment such as microscopes. Their learning was evident in performances, products, projects, art exhibits, journals, as well as their enthusiasm and excitement. A synthesis of understanding the concept of metamorphosis and the life cycle is illustrated in Fig. 3 produced as a pre-school collaborative project with each child's name on his/her part.

English language arts (ELA) skills were the second most tagged standards set. The two most prominent in the activities were listed in the Standards for the English Language Arts (International Reading Association and National Council of Teachers of English 1996, p. 3) as 7 and 8.

Standard 7. Students conduct research on issues and interests by generating ideas and questions, and by posing problems. They gather, evaluate, and synthesize data from a variety of sources communicate their discoveries in ways that suit their purpose and audience.

Standard 8. Students use a variety of technological and informational resources (e.g., libraries, databases, computer networks, video) to gather and synthesize information and to create and communicate knowledge.

All science curricula require basic ELA skills, i.e. vocabulary, reading comprehension, and research skills. ELA in *A Dance with the Butterflies* project was evident in oral and written communication as dramatic readings, poetry, journals, stories and reports produced for publication on the web for the other teacher participants and their students to see, read, and enjoy. The imagination and creativity applied in student writing is illustrated in Fig. 4.

Other applications for developing skills in English language arts were used in the project. The UDL application of text-to-speech, new to many of teacher participants and their students, proved to be an effective multimedia approach to integrate science and language arts. Students thought it was fun to listen to the computer read their words. The use of graphic organizers, discussions on copyright and plagiarism, and vocabulary reinforcement games were valuable by-products for extensions of learning and opportunities to 'seize the teachable moment' as they arose. Students were actively engaged in developing their own learning tools, games, posters, multimedia and dramatic interpretations to reinforce the concepts of the life cycle and associated vocabulary. All were posted on the project website for an authentic audience.

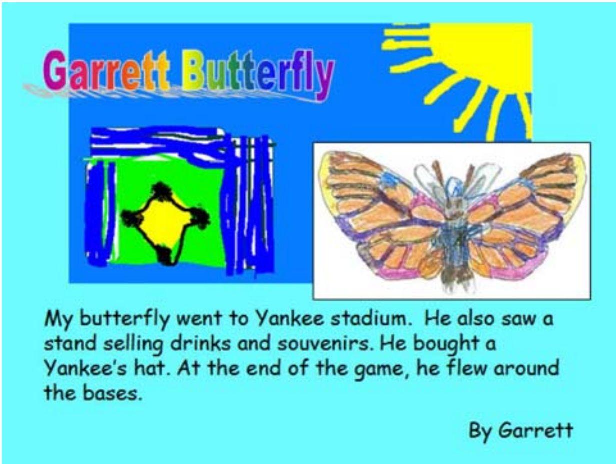

Fig. 4 Journal of a butterfly at baseball game

This collaborative project was also an excellent launch for developing geography map-reading skills. The National Council for Geography Education organizes the their standards around Essential Elements a geographically informed person knows and understands. Standard 1 for Essential Element I, World in Spatial Terms is "How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective" (National Geography Standards, Geography Education Standards Project 1994). Students participating in this project used maps extensively to locate butterfly habitats and their migration courses, to research seasons and climate in various regions of the world that support the life of butterflies, and to find locations of species indigenous to other areas of the country and world. Both the whereabouts of participants and the locales of butterflies gave an authentic global perspective to the project increasing students' awareness of the world. One teacher participant even traveled to Mexico to trace the migration of butterflies studied in the project giving her students first-hand information of other regions of the world.

The flexibility of a variety of materials and methods for engaging in learning provides connections for other interdisciplinary activities. We have seen English language arts in instructional activities to develop reading, vocabulary development, and comprehension skills and geography in map reading skills. Interdisciplinary activities included mathematics as well. Students made chart and graphs of the amount of daily food consumption, illustrated geometrical symmetry of butterfly body parts and color patterns, and practiced number operations in a subtraction game represented by caterpillars eating leaves. These activities reinforced the focal points for Pre-K through 8th grade mathematics standards specifically the one stating, "To build students' strength in the use of mathematical processes, instruction in these content areas should incorporate an involvement in the design and analysis of multiple representations to learn, make connections among, and communicate about the ideas within and outside of mathematics" (National Council of Teachers of Mathematics 2006). The interdisciplinary activities even extended to foreign language instruction. For one class that introduces Spanish in kindergarten, project activities included Spanish songs, art projects, and stories to develop vocabulary and comprehension skills and multiculturalism awareness (Fig. 5).

Fig. 5 Butterfly metamorphosis science terms in Spanish

Assessment Strategies

A critical point in the instructional planning cycle is assessing student progress. The CAST research suggests that applying the principles of flexibility in representation, strategic support and expression, and engagement will provide a more accurate assessment of student learning (Rose and Meyer 2002, pp. 137–155.) Participants applied the principles of assessing learning in multiple ways. Some used a pre/post method of assessing learning while others followed a K–W–L procedure (Ogle 1986). Traditional multiple-choice and matching responses assessed learning at times, but the focus was on authentic project-based learning and performance. Students were able to show what they had learned through a variety of projects by drawing and creating models of the life cycle labeling items with their new vocabulary; some wrote stories, poems, journals; and others used their artistic modalities in music, dramatic skits, puppet shows, and dance. Some projects were designed using Kidspiration™ and Inspiration™ to create the life cycle sequence or KidPix for student collaboration to portray the metamorphosis. Works of art were scanned and digital cameras captured the 3-D models, skits and puppet shows. Recordings of students singing were made and imported for posting on the project website. Photos of their projects, videos of their performances, and electronic files of their writing and presentations were posted in the Student Showcase for the other teacher participants and their students in other states and countries to see and celebrate. An authentic audience beyond the classroom and into the far corners of the world was a terrific motivator for the students—they were very excited to share their new knowledge. One teacher reflected, “This project was very challenging, but took all my students to new heights! It was a completely new experience. They enjoyed the work on their projects and were very proud of their final presentations”.

Building a background of knowledge through authentic learning experiences and audiences, students develop confidence and interest in learning critical for advancing to more complex concepts and higher levels of thinking. The flexibility and variety of learning experiences designed according to the principles of UDL tap into the affective networks producing the motivation and engagement for finding value and joy for learning.

Affective Networks

The affective networks attach the emotional significance to learning. All learners exhibit some differences in their motivation and engagement with learning tasks (Rose and Meyer 2002, p. 32). The affective network may be the most critical to learning but is given the least priority in preservice or in-service preparation programs. Students constantly ask ‘why do I need to know this?’ Teachers face a tremendous challenge to nurture their students so that they develop a love for learning, find joy in challenge, connect to content, and persist in the face of difficulty. Students need to understand the *why* of learning to be fully engaged in the learning process. Activating the affective networks for learning by giving students choices in their own learning and alternative ways to demonstrate what they know and are able to do can go a long way in student learning. The UDL principles of multiple and flexible representation, expression, and engagement call for appropriately challenging instruction, reading materials and meaningful tasks. Interests, abilities, rewards and responsibility are key influences on the affective networks. In this project multiple intelligences and talents were tapped for learning science. The students produced various visual art works, engaged in singing, dancing, puppet shows, and skits, and designed board games and puzzles—all to convey the butterflies’ metamorphosis (Fig. 6).

The authentic experience of working with the living creatures and opportunities to observe the metamorphosis connected students to the content. They actually witnessed all the stages of the life cycle. Unfortunately the authenticity even exposed the children to death. Some caterpillar specimens that came in the butterflies kits did not survive creating a ‘teachable moment’ to explain death as part of the life cycle and provide strategies to deal with emotions associated with loss of life.

Fig. 6 Board game using life cycle stages vocabulary

Students were given choices for what activities they wanted to do. Participants reported that this gave students ownership of their own learning working in groups or independently. With choice they were also given challenges. They were eager to start their projects and enthusiastic about learning. Observing the butterflies’ metamorphosis was exciting—all very effective for triggering the affective networks critical to learning.

Teacher Participants’ Support

The *Dance with the Butterflies* website was integral to this collaborative project with new information and ideas for teaching and learning that supported teacher participants. The website housed the introduction and invitation to join the collaboration. Web links to resources for ideas and information supported the participants in their own planning for applying UDL to their instruction. The Curriculum Materials portion of the project website provided resources for UDL, and resources on butterflies, books, virtual exhibits, picture galleries, and technology tools such as text readers.

A blog was designed and linked to the website to support the participants in their understanding of UDL (http://butterflydanceproject.blogspot.com/). The blog provided a forum for teacher participants to discuss, clarify and validate their understanding of the UDL concepts and ideas for applications in their instruction. Project leaders posted examples and explanations to clarify UDL in the context of the life cycle metamorphosis curriculum. Teacher participants shared resources applicable to the project, such as books, websites, and educational software. Sample videos, graphics, and podcasts were posted. The blog was an important connection for the teacher participants' collaboration with each other and for the support of their own learning.

The blog became such a rich resource that even those participants who were reluctant at first started coming to the blog seeking support and advice. It was a place to celebrate students' creativity and mastery of new content and new technologies as well as to console each other when the live specimens died. Participant teachers were enthusiastic about sharing with frequent conversations and demonstrations of how to use new technologies. They used digital cameras to capture photos and learned ways to share them in the blog using a program called Flickr™. They also experimented with technology for recording sound clips and shared their new learning on the blog. Everything the teacher participants learned they used in their teaching. Student art work was scanned or photographed; skits, puppet shows, singing and dancing were recorded; games designed; and journals written—all for sharing new knowledge with others.

Sharing also extended to the parents and the community. Students' projects were displayed for a parent night so that the parents could see their children's creativity and excitement for what they had learned. The project extended to the home as a family literacy discovery of nature activity. The home/school connection was an excellent way to support language development while reading, learning new vocabulary, and discussing butterflies and caterpillars at the dinner table.

Summary

The project *A Dance with the Butterflies* was truly a magical experience for all involved. The effectiveness of planning instruction to address the neurological networks for learning was evident in the children's products and performances. Recognition networks were activated through the myriad of strategies to introduce the concepts of the life cycle, i.e. books, pictures, videos; conceptual interpretation of the information controlled by strategic networks was expressed in the student projects; the enthusiasm, creativity and high interest level were indicators of positive responses of the affective networks.

The project provided countless examples of how student knowledge and understanding can be demonstrated in creative ways—far beyond the expectations of the project leaders. Creative approaches to instruction tap into the diversity of children in today's classrooms—their diverse talents, abilities, interests, and learning styles. As one teacher said, "collaborating with colleagues inspired me to take the butterfly experience for my students into new places with technology, differentiation, and accessibility".

Flexibility in *how* to learn empowers children to take responsibility for their own learning and to develop sufficient confidence and appreciation new knowledge. The *Dance with the Butterflies* was an instructional metamorphosis engaging students in learning experiences in ways that they learn best. With positive learning experiences children are prepared to become successful life-long learners, just as the caterpillar evolves to become a beautiful butterfly.

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Resources

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Apple Student Gallery. http://edcommunity.apple.com/gallery/student/item.php?itemID=1504.

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Howard Hughes Medical Institute. http://www.hhmi.org/coolscience/butterfly/index.html. Courtesy of the Scotia-Glenville Children's Museum, Scotia, New York.

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Study of the Impact of Universal Design for Learning in the Elementary Classroom

Dissertation

Submitted to Northcentral University

Graduate Faculty of the School of Education
in Partial Fulfillment of the
Requirements for the Degree of

DOCTOR OF EDUCATION

by

ANNE F. THORP

Prescott, Arizona
October 2008

APPROVAL

Study of the Impact of Universal Design for Learning in the Elementary Classroom

by

Anne F. Thorp

Approved by:

Dr. Shad Bailey, Ph.D 11/13/08

Chair: *Dr. Shad Bailey, Ph.D.* Date

Member: *Dr. Tony Pellegrini, Ed.D.*

Member: *Dr. Troy Robinson, Ed.D.*

Certified by:

Dr Angie Parker 11/18/08

School Dean: *Angie Parker, Ph.D.* Date

ABSTRACT

Study of the Impact of Universal Design for Learning in the Elementary Classroom

by

Anne F. Thorp

Northcentral University

September, 2008

Today's diverse classrooms include students of all academic levels, needs, learning styles, languages, and abilities. With the implementation of No Child Left Behind (2001), students with diverse learning needs, such as special education students with an Individual Education Plan, or second language learners, are required to learn the same information as the general education curriculum for the purposes of testing. No Child Left Behind reports indicate that at least one quarter of United States schools are struggling to achieve Annual Yearly Progress (AYP). Furthermore, now that the Higher Education Opportunity Act (HEOA) (Public Law 110-315) enacted August 14, 2008 contains provisions for Universal Design for Learning (UDL), research to show its benefit to teacher preparation and student learning may guide educators of all levels in the implementation of UDL to meet the needs of learners of all ages. Through the application of Universal Design for Learning (UDL) principles, higher levels of success may take place in classrooms in spite of the diverse needs of students leading schools to achieve AYP. In order to determine the benefits and best practices or processes of Universal Design for Learning implementation, a sound research design must be implemented. The key question researched here is whether or not the implementation of UDL principles impacted fourth grade students' reading grades. A one tailed *t*-test analysis was conducted for this study, comparing grades prior to and after the implementation of UDL into the classroom. This study used a combination of qualitative and quantitative data gathered during research. Report card reading grades determined the quantitative outcomes, and then teacher and student follow-up surveys comprised the qualitative data. The purpose of this research is to determine whether student learning is greater than, equal to, or less than in one setting over the other. This study examined student-learning data prior to the implementation of the principles of UDL and the impact of the implementation on student achievement, participation, and interactivity. Research outcomes indicate that the implementation of UDL into the elementary classroom has a positive impact on student learning in a variety of ways.

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This work is dedicated to learners of all ages everywhere.

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CHAPTER 1: INTRODUCTION

Introduction

Today's classrooms include students of all academic levels, needs, learning styles, languages, and abilities. With the implementation of No Child Left Behind (2001), students with diverse learning needs such as special education students with an Individual Education Plan, or second language learners, are required to learn through the general education curriculum for the purposes of testing. Additionally, classrooms are filled with learners of different styles, needs, and background knowledge. Meeting the needs of students with different learning styles is a significant element in the teaching and reaching of diverse learners. Through the application of Universal Design for Learning principles, higher levels of success may take place in classrooms in spite of the diverse needs of students regardless of the types of differences these students bring to the classroom.

Statement of the Problem

Because NCLB reports indicate schools are struggling to meet Adequate Yearly Progress (AYP) programs to increase student achievement are quickly being developed. Since NCLB mandates all students learn through the general education curriculum, educators and students would benefit from curriculum adjustments in order to increase achievement for all in today's classrooms of diverse learners. Universal Design for Learning (UDL) principles implemented into the classroom curriculum may be the answer to teachers' and principals' wishes for increased AYP scores. In February 2007, the UDL Taskforce sponsored a congressional briefing that included UDL. The outcome of that briefing concluded with the signing of Higher Education Opportunity Act (HEOA) into law on August 14, 2008 by President George W. Bush. This HEOA includes UDL in the practices of teacher preparation, school report cards, meeting the needs of varied learners in higher education, and using technology to prepare teachers to meet the needs of digital learners (National Design for Learning Taskforce, 2008). The addition of UDL to the HOEA brings the awareness of its strengths and the possibilities of increased learning to the forefront in teacher preparation and meeting the needs of all students. Additionally, new teachers coming into the field will be well prepared to meet the needs of the diverse population they will face in their classrooms. Studying the benefits of UDL in the classroom may bring further awareness of its power as well as indicate the increase in student learning that its adoption conveys.

Studies such as this one may bring awareness to the variety of technologies, processes, and learning issues that the implementation of UDL may employ. Additionally, studies of the integration of UDL principles may lead to further understanding and implementation of the principles and processes of UDL for the betterment of teaching and learning.

Background and Significance of the Problem

Today's classrooms are composed of students of all academic levels, needs, learning styles, and abilities. With the implementation of NCLB (United States Department of Education, 2002) students with diverse learning needs such as special education students with an Individual Education Plan (IEP) or second language learners are required to learn materials commensurate with the general education curriculum. To illustrate how this mandate, achieving AYP, has proved to be a daunting task for teachers and students, Jennings (2004) reported that in 2003 about 32% of the schools evaluated did not meet the AYP for at least that year and about 7% did not meet AYP for two years. According to the National Education Association (2008), the percentage of schools not making AYP in the 2007-08 School Year is 28.1 and the percentage of schools in Improvement/Corrective Action is 13%.

One possible solution to moving more schools toward the achievement of AYP is Universal Design for Learning. UDL is an instructional approach incorporating technology in order to guide students with varied learning needs to reach success in their learning environment.

The Kentucky Department of Education describes UDL

> Delivering curriculum and implementing instruction through the lens of Universal Design means considering the needs of a wide range of learners, including strengths, weaknesses, and learning styles. Instead of retrofitting a pre-designed curriculum, teachers design and plan instruction to meet a wide variety of needs of their students, and considering individual differences. (2007 ¶ 1)

UDL is not another product teachers need to implement into their classrooms, but is a framework that taps into recent brain research that indicates that all brains learn differently (CAST, 2007). UDL offers applications to provide access to the general education curriculum in order to meet the needs of all students, regardless of learning style. UDL offers a structure for specialized goals and gathering curriculum resources with various media, stages of challenge, and learning scaffolds, allowing all students to learn through the general education curriculum. According to The Center for Applied Special Technology (CAST), "This is accomplished by simultaneously providing rich supports for learning and reducing barriers to the curriculum, while maintaining high achievement standards for all students" (2007, ¶ 1). Additionally, CAST pointed out that "Universal Design for Learning is a framework that enables educators to develop curricula that truly 'leave no child behind' by maintaining high expectations for all students while effectively meeting diverse learning needs" (2007, ¶ 5).

With the flexibility of digital access and media available today, learners are provided greater opportunities for learning through individual means. UDL principles are based on recent brain research showing that there are three primary networks in the brain: (a) The recognition network is how the brain gathers facts and identifies the "what" of learning; (b) The strategic network is the planning network of the brain and is significant in identifying the "how" of learning; and (c) The third network is the affective network, which is the network of engagement and motivation and is a key identifier in the "why" of learning.

Application of these principles is accomplished through multiple and flexible means of representation, expression, and options for engagement. The word "Universal" in UDL does not mean that there is a single answer for every learning need. It is "meant to underscore the need for multiple approaches to meet the needs of diverse learners" (CAST, 2007, ¶ 4). Burgstahler (2002), CAST (2006), and the Council for Exceptional Children (CEC) (2005) indicated that studies are just beginning to emerge on the effects of UDL principles implemented into the classroom curriculum. Through the application of UDL principles, higher levels of success may take place.

Forty-five of the 50 states are addressing the emerging practice of Universal Design according to the National Center on Educational Outcomes in a document titled *2005 State Special Education Outcomes: Steps Forward in a Decade of Change* (Altman, Johnstone, Thompson, & Thurlow, 2005). Iowa, New Jersey, Minnesota, South Dakota, and Washington were not addressing Universal Design at the time of publication (Altman, Johnstone, Thompson, & Thurlow, 2005).

Kentucky's program regulations require that instructional materials and technologies to be considered for state adoption "must be made available by publishers in accessible digital format" (Kentucky Department of Education, 2008, ¶ 3). Teachers across Kentucky are participating in the professional development programs offered for the successful implementation of UDL into their classrooms. Additionally, the Kentucky Accessible Materials Database (KAMD) provides an opportunity for state schools to locate materials that are available digitally.

Hebert and Williams (2006) asserted

> The mission of the Louisiana Universal Design for Learning (UDL) initiative is to design and implement a model for teaching and learning that will meet the needs of all learners through the use of best practices, adaptive technologies, and instructional techniques to accommodate all teaching and learning styles. (¶ 1)

Louisiana provides opportunities for their teachers to learn UDL principle implementation through their program called Bridging the Gap through UDL. The Louisiana Department of Education described this program as "Bridging the Gap through Universal Design for Learning. (UDL) is a DOE cross-division initiative for educators who are committed to improving educational outcomes for all learners" (2007, ¶ 1).

Michigan's Local Education Agencies are also participating in UDL's growth. Agencies across Michigan are participating in The Rescue (Reading E-text SCanned for Universal Education) Project that

> Intends to provide alternative format, specifically electronic text, of printed curriculum materials (textbooks, novels, and so forth) to students with disabilities. By providing curriculum materials in electronic format to school districts, students with disabilities can utilize various technologies to assist them with reading. In this way, all students will be able to access their school's curriculum to acquire knowledge. (Ingham ISD, 2008 ¶ 1)

The Rescue Project maintains a book directory to help teachers learn which books are available to their students. Additionally, the Michigan Integrated Technology Supports (MITS) "provides informational services, support materials, and professional learning opportunities to improve outcomes for all students" (MITS, 2007, ¶ 1). MITS is "a Mandated Activities Project of the Michigan Department of Education, Office of Special Education and Early Intervention Services" (MITS, 2007, ¶ 1). Furthermore, Michigan's Regional Educational Media Centers (REMC) provides many supports for teachers in order to bring UDL into their classrooms. For example, the REMC Association of Michigan (REMCAM) provides subscriptions to Discovery Education *streaming* for every member. In addition, REMCAM provides access to digital materials and a statewide School Aggregated Volume Buy Catalog for Education programs where schools can locate a variety of educational resources at discounted prices.

The purpose of this study was to determine the impact of UDL implementation on student achievement in classrooms of diverse learners through the addition of technology implementation. Technologies used in this study included the use of Discovery Education *streaming*, Inspiration®, the Microsoft built in accessibility supports on school and classroom computers, and the Classroom Performance System (CPS).

Discovery Education *streaming* "is a digital video-on-demand and online teaching service" (Discovery, 2008, ¶ 1). Discovery Education *streaming* contains over 7,700 videos, many with closed captioning options, and Spanish titles from over 100 educational publishers. Additionally, Discovery Education *streaming* contains audio files, editable clips, and over 23,000 images along with customizable options for creating assignments and quizzes to differentiate learning. School resources and an educator network are part of Discovery Education's Discovery Education *streaming* package. While Discovery Education *streaming* was used for this study, there are websites available where videos are obtainable for teacher use at no cost. The significance of these sites is for teachers or districts who do not subscribe to Discovery

Education *streaming* so they may also benefit from these resources. Websites such as The Research Channel (http://www.researchchannel.org/prog/), Annenberg Teacher Resources, (http://www.learner.org/resources/browse.html), and National Geographic (http://video.nationalgeographic.com/video/) provide digital videos online that can be used in the classroom.

Inspiration® is a mind mapping software that allows teachers and students to research and plan projects through graphically organizing their thoughts and ideas, which can then be transformed into an outline with the click of a button. Inspiration® is described as "The essential tool to visualize, think, organize, and learn" (Inspiration®, 2008, ¶ 1). I Inspiration® can be purchased by individual license or by volume for labs or schools. Volume license costs are dealt with through the company based on the number of licenses needed. An alternative to I Inspiration® is a product called FreeMind, a program to download directly from the Internet at no cost. FreeMind is very much like Inspiration® in its look, functionality, and goals, all without the cost. FreeMind can be found at http://freemind.sourceforge.net/wiki/index.php/Main_Page.

The Classroom Performance System (CPS) is an interactive software program on the computer that the teacher can set up as a game, quiz, test, or team activity. The computer is then connected to a projector and students participate in the activity by handheld remote keypads. As students respond, the software program keeps track of responses and gives instant feedback to the teacher and students. The cost of the CPS varies by the number of responders purchased, and the type of responder, (e.g. infrared or radio frequency). CPS information can be found at http://www.einstruction.com/.

Microsoft built in accessibility supports on school and classroom computers were made available for students to set to meet their learning needs. The Microsoft accessibility options allow users to configure and personalize computer functions to best fit their vision, hearing, and mobility needs. Students were taught these functions after which they personalized their district account to meet their learning and computer needs.

The goal of this study was to evaluate the use of UDL through technology in two fourth grade classrooms. The findings of this study might lead to an understanding of UDL principles and their relationship to curriculum development through technology intervention. It is expected to result in higher achievement for students in the classroom. The findings of this study may shed light on improvements in delivery and teaching established through the implementation of UDL principles. Additionally, it may bring an awareness of approaches in the diverse classroom through the implementation of simple technology strategies.

Research Questions

In order to complete a comparative analysis of student learning in classrooms before and after UDL principles are implemented, significant questions must be answered such as, "Does the implementation of UDL principles increase student achievement?" Based on the researcher's experience and the research of Casper and Leuchovius (2005) and Meyer and Rose (2002), results might show student achievement is increased because of the implementation of UDL principles. Due to students' learning through a flexible curriculum and using materials that are not 'one size fits all' but are adapted to meet learning needs of individual students, increased participation, motivation, and learning might take place. A subset of research questions for this study included:

1. How does student achievement prior to UDL implementation compare to achievement after UDL implementation?

2. Is student achievement in UDL classrooms equal to or above achievement prior to UDL implementation?

3. Does individual student participation increase in UDL classrooms as compared to participation prior to implementation of UDL principles into the classroom?

4. Do students in UDL classrooms incorporating technology tools engage interactively as frequently as prior to UDL implementation?

These questions guided this research study in determining the benefits of UDL implementation into curriculum, teaching strategies, and classroom processes.

Definition of Terms

Adequate Yearly Progress (AYP). A measure of a school's or school system's ability to meet required federal benchmarks with specific performance standards from year to year (Knox, 2004).

General Curriculum. The same curriculum as that provided to students without disabilities (Karger, 2004).

No Child Left Behind (NCLB). It was implemented during the 2002-2003 school year. It requires schools to have 100% proficiency among students in math, reading and language arts by 2014. They must also meet graduation and attendance standards (Knox, 2004).

Universal Design for Learning (UDL). A framework for designing curricula that enables all individuals to gain knowledge, skills, and enthusiasm for learning. UDL provides rich supports for learning and reduces barriers to the curriculum while maintaining high achievement standards for all (CAST).

Highlights and Limitations of Methodology

The elementary classroom was chosen as the location for the undertaking of this study of UDL technology integration. Studies located thus far have been based on middle school case studies of UDL processes and implementations (CAST) or surveys based on opinion of the integration of technologies in the classroom in a high school setting (McClannon, 2006). A study of the impact of UDL on grades and student achievement had not been previously completed or located. Previous studies of this type have not been found; therefore, this study is not a replication of any preceding studies or study. New research is a necessity to further understand the impact of UDL implementation in diverse classrooms. In order to advocate the implementation of UDL into new and existing curriculum, it is essential that research studies show success through increased student achievement. The purpose of this study is to determine the impact of UDL, through technology implementation, on student achievement in classrooms of diverse learners.

The goal of this study is to complete an evaluation of UDL implementation in two fourth grade classrooms. Fourth grade is the chosen grade level since this grade level has had four years of education and intervention, as well as the idea that maturation has leveled off so as not to interfere with study results. Younger grade levels may still have growth in maturity, which may create a challenge in determining if maturation or UDL strategies affected the outcome of the study and impacted student learning and success. Implementing a new method of teaching and learning in any age group may demonstrate clearly the success of UDL principles. However, for the purpose of the study fourth grade has been selected.

While the results of this study may be revised to meet any grade level, this project may lead to an understanding of UDL principles and their relationship to technology use and curriculum development. The implementation of UDL principles in this study are expected to result in higher achievement for students in participating classrooms.

For the purposes of this study, the ultimate goal of UDL as described by the Council for Exceptional Children is to, "appropriately challenge and effectively engage the full range of students: those with disabilities and those without, those who are average, as well as those who are below and above average" (2006, p. xii). Once an understanding of UDL principles and teaching methods is realized, improvements in delivery and teaching approaches can be created in order to continuously increase student learning and create best practices for teaching delivery in the diverse classroom. Additionally, professional development for teachers desiring to implement UDL principles may be impacted by the results of the study, in that a positive correlation may lead teachers to understand clearly the benefits of such an implementation into teaching strategies. Furthermore, higher education implementing UDL into teacher preparation may benefit from studies of the impact UDL principles have on learning and student success.

This study is designed to assess the impact UDL implementation has on the classroom with additional technology use taking place on a regular basis. While both internal and external validity are significant factors in any research project, in this case external validity is crucial as results may be generalized and applied to other situations, groups, and populations to further understand the benefit of UDL implementation into classroom curricula. Additionally, study results may be duplicated for further study and implementation. Internal validity will be more of a challenge to maintain, as there will be variables over which the researcher has little or no control. These variables include parental support of the study, daily classroom schedules, as well as student and teacher attitude toward the implementation process of the UDL principles and technologies. These factors may create validity and reliability issues that the researcher has not only no control over, but also in the level of consistency with the testing instrument with this particular group of participants.

This study reviewed reading grades given by current classrooms teacher at the end of the report card marking period and compared them to grades earned in the final marking period. Teachers used their usual teaching strategies in the classroom until the end of the second grading period when they began the implementation of the newly learned UDL strategies into the classroom. This method allowed teachers to observe students in the general education classroom as well as assess student-learning styles while learning the technologies and UDL strategies that will be implemented into the classroom. Using report card grades before and after UDL implementation may guide classroom teachers to determine which strategies are successful in reaching learners. Additionally, the report card differential may lead the researcher to more closely determine strategies that indicate more success than others.

The Michigan Educational Assessment Program (MEAP) test is administered early in the school year. This assessment is given too early in the school year to be used to determine results based on any implementation of UDL principles in the classroom; therefore, those scores will not be factored into this study. The MEAP is given in early October and scores are not reported until the next calendar year. Using the MEAP results as a measure of UDL impact would not be an effective measure since there would not be enough time in the school year to implement principles to affect MEAP scores. Additionally, if MEAP scores were considered, the test scores that would be reviewed would have been from another year, another teacher, possibly even another school, therefore making those scores not in accordance with this study's goals.

Comparing reading grades before and after UDL implementation may bring significant information on how this process might assist raising scores to increase success and achieve AYP.

Even thought this study focuses on report card grades, the standards being taught in the classroom are the same standards, benchmarks, and grade level content expectations measured on the MEAP.

Maturation is another consideration as a threat to internal validity. Anytime children are involved in a study, there is the possibility of this threat since the children are growing, learning, and applying their learning throughout the term of the study. According to RAVID,

> Maturation is a particular threat to internal validity in studies that last for a longer period of time (as opposed to short-duration studies), or in studies that involve young children who experience rapid changes in their development within a short period of time. For example, suppose researchers want to enhance fine motor coordination of preschoolers by providing special time each week for them to practice tying their shoes. Before and after a six-month program, the children's coordination is tested. A significant improvement in the children skills in tying their shoes may be due to the intervention (practice time). However, it is also possible that the children are better able to perform certain tasks that require fine motor coordination simply because they are older. (2005, p. 7)

While this will not be a long-term study, the threat of maturation may be present if the study subjects are a group of younger students such as second or third graders early in the school year who are still learning classroom practices, to read fluently, and to follow directions intrinsically. Even the course of six weeks at these ages may indicate maturation in the classroom. In the case of a group of older students, such as fourth or fifth graders, maturation from the beginning may not pose as large a threat as their rate of growth has leveled. To avoid the threat of maturation validity, this research focuses on a group of older students with

Curriculum Planning for All Learners: Applying Universal Design for Learning (UDL) to a High School Reading Comprehension Program

Grace Meo

ABSTRACT: The universal design for learning (UDL) principles provide a blueprint for designing a curriculum that addresses the diverse needs of all learners. The author provides an overview of UDL, connections to curriculum planning, and practical techniques that guide general and special education teachers in planning and implementing curriculum, using the planning for all learners (PAL) procedures. PAL is a 4-step process for designing and implementing a curriculum (goals, methods, materials, and assessments) that is accessible and effective for all learners. In this article, the author focuses on high school social studies content with a goal of supporting all students' understanding of the content by bringing together principles of UDL, the PAL process, and research-based reading comprehension strategies.

KEYWORDS: *accessibility, curriculum planning and instruction, reading comprehension, secondary school, universal design for learning*

IN THE FALL, high school teachers across the nation return to their classrooms with varied expectations and goals. Many are ready to meet the challenges of the new school year that include preparing all students for state-mandated achievement tests and ensuring that students make progress understanding course content. These teachers know the standards as defined by their state and local districts and recognize that they are accountable for all students' performance in reaching these standards. Students also approach the new year with diverse expectations. For instance, some are eager to get a fresh start this year and earn good grades. These "regular" students easily meet their teachers' expectations and the district standards.

Then there are "special" students who reluctantly enter the high school classroom, knowing that failure is the likely result again this year no matter how hard they try. These students encounter many obstacles during each school day, ranging from not being able to read the textbook to having insufficient background knowledge to understand the course content. Their day is filled with barriers that make learning difficult. They must change something about themselves to succeed—if only they knew what. These students keep a teacher up at night trying to adapt course content to meet their needs, figuring out how to encourage each one to try harder, or, in some cases, looking for an alternate route that may include both a different curriculum and a different classroom setting. None of these solutions best serves the diversity of today's student population. Rather, they place incredible burdens on teachers and students alike to adapt to an inflexible, barrier-filled curriculum. Educators do not seem to question whether the burden of adaptation should fall on the curriculum itself—that the curriculum, and not the students labeled "special," is what needs fixing.

Many regular students also struggle to succeed in a one-size-fits-all regular-education curriculum. However, recent brain research and theories of learning clearly indicate that each learner is special (i.e., unique), with varied abilities and qualities, and that the typical classroom represents a vast range of learner differences (Meyer & Rose, 2000; Rose & Meyer, 2002). In fact, categorizing students into two groups—regular and special—oversimplifies learner differences and fails to accurately represent the diversity of today's high school student population.

To ensure that all students have genuine opportunities to learn in standards-based settings, educators need to develop a new understanding of learner differences. Whereas learner differences have been traditionally defined as inherent strengths and weaknesses of students themselves (without regard for weaknesses in the curriculum itself, which

Grace Meo *is a director of professional development and outreach services at the Center for Applied Special Technology (CAST) in Wakefield, MA. Her research interests include staff development for educator and teacher candidates. She is also interested in development of curriculum and the process that teachers undergo when they address diversity in classrooms.*

has been regarded as static and infallible), the interaction between the learner and the educational curriculum must be considered (Meyer & Rose, 2005). In other words, in looking for ways to include all learners in high-quality, standards-based educational settings, educators and researchers should examine ways in which the curriculum presents barriers and supports to academic achievement by diverse learners and how the curriculum can be developed to include all learners from the outset.

One framework for addressing the diversity of all students and creating a flexible curriculum that supports access, participation, and progress for all learners is universal design for learning (UDL; Meyer & Rose, 2000; Rose & Meyer, 2002). As a framework for creating a flexible curriculum, which in standards-based settings includes instructional goals, methods, assessments, and materials, UDL takes advantage of innovative technologies to accommodate learner differences.

General and special education legislation (e.g., No Child Left Behind Act of 2001, the Individuals With Disabilities Education Act of 2004) recognizes the right of all learners to a high-quality standards-based education, and it holds schools responsible for student progress. Yet such laws do little to address the biggest impediment to improving student outcomes: the curriculum, which is often not flexible enough to enable teachers to meet the needs of diverse learners.

By addressing the diversity of learners at the point of curriculum development rather than as an afterthought or retrofit, UDL helps educators to develop curricula that truly leave no child behind while maintaining high expectations for all students, including those with disabilities. In this article, I describe the UDL framework and a process for applying the concepts of UDL to planning curriculum. In addition, I present a case story of a high school teacher who uses the UDL framework and curriculum planning process for designing lessons.

A Blueprint For Teaching Every Student: UDL

Drawing on advances in neuroscience and new insights into the nature of learning differences, *universal design for learning* (UDL) is an approach to designing curricula—including instructional goals, methods, materials, and assessments—that are flexible enough from the outset to accommodate learner differences (Meyer & Rose, 1998, 2000, 2005; Rose & Meyer, 2002). According to Rose and Meyer (2002), UDL is built on the premise that "barriers to learning occur in the interaction with the curriculum—they are not inherent solely in the capacity of the learner. Thus, when education fails, the curriculum, not the learner should take the responsibility for adaptation" (p. 20).

To better understand UDL, visualize an individual in a wheelchair as he or she approaches a street intersection. Before curb cuts, it was nearly impossible for this individual to cross the street; however, with the universal design movement in architecture and the passage of the federal Americans With Disabilities Act in 1990, which mandated accessibility in public spaces for individuals with disabilities, curb cuts are typically built into new sidewalks. Of course, curb cuts improve access not only for individuals with disabilities but for others, such as those pushing baby carriages or pulling a wheeled bag. This is a hallmark of universal design: increasing flexibility and accessibility ultimately benefits everyone, including those whom the innovations were not explicitly intended to help.

Similarly, when a curriculum is universally designed to enable all kinds of learners to access and progress in the curriculum, all students—including those who do not have special needs per se—will benefit from having more flexible learning environments. UDL is a means of identifying and removing barriers in the curriculum while building scaffolds, supports, and alternatives that meet the learning needs of a wide range of students. Specifically, a UDL curriculum is characterized by the provision of:

1. multiple or flexible representations of information and concepts (the "what" of learning),
2. multiple or flexible options in expression and performance (the "how" of learning), and
3. multiple or flexible ways to engage learners in the curriculum (the "why" of learning; Rose & Meyer, 2002).

Bringing UDL into classrooms and educational practice may sound like a difficult task, and it is, if a classroom is guided by vaguely defined goals and equipped with only conventional instructional methods, traditional materials (e.g., textbooks and pencils), and inflexible options for demonstrating knowledge and understanding (e.g., written responses, either essay or multiple choice). For that reason, the UDL framework addresses the whole curriculum—goals, materials, methods, and assessments—to make it more accessible not only physically but also intellectually and emotionally (Hitchcock, Meyer, Rose, & Jackson, 2002; Jackson & Harper, 2005). In specific application, then, UDL calls for:

1. Defining goals that provide appropriate challenges for all students, ensuring that the means is not a part of the goal.
2. Using methods that are flexible and diverse enough to support and challenge all learners.
3. Using materials that are flexible and varied and take advantage of the digital media, such as digitized text, multimedia software, video recorders, tape recorders, and the Internet.
4. Using assessment techniques that are sufficiently flexible to provide ongoing, accurate information to inform instruction and determine student understanding and knowledge (Rose & Meyer, 2002).

As a relatively new framework, the literature on UDL is still evolving. Empirical studies documenting the impact of the UDL approach have focused primarily on literacy applications (Dalton, Pisha, Eagleton, Coyne, & Deysher, 2002; Proctor, Dalton, & Grisham, in press). Such studies have demonstrated positive outcomes for struggling readers using a UDL approach. In addition, the principles and practices of UDL are rooted in a number of research-proven educational approaches with which teachers may already be familiar. It draws on and extends aspects of differentiated instruction (Tomlinson, 1999), which teachers use to individualize criteria for student success, teaching methods, and means of student expression while monitoring student progress. UDL emphasizes teachers as coaches or guides (O'Donnell, 1998), learning as process (Graves, Cooke, & Laberge, 1983), and cooperative learning (Johnson & Johnson, 1986; Wood, Algozzine, & Avett, 1993). In these approaches, teachers support learning rather than impart knowledge, and students construct knowledge rather than passively receive it. UDL represents a shift in how educators look at learner differences. It emphasizes the need for a curriculum that can adapt to student needs rather than requiring learners to adapt to an inflexible curriculum (Meyer & Rose, 2005).

Planning For All Learners: Connecting UDL To Curriculum Planning

Planning curriculum that supports all learners is a challenge given the diversity of high school classrooms and the mandate that all learners make adequate progress in the general education curriculum. In response to this challenge, the Center for Applied Special Technology (CAST; 2004) developed *planning for all learners* (PAL), a process for developing curricula that addresses the diversity of today's classrooms. Although the PAL process can be applied to varied content areas, in this article, I focus on applying these methods to support the development of high school students' reading vocabulary and reading comprehension.

Reading comprehension is a prerequisite skill for academic success in all areas of the curriculum and a significant challenge for many students, even at the high school level. As reported from the results of the 2002 National Assessment of Education Progress, 26% of 8th grade students in the United States performed below basic reading level, and an identical percent performed below basic competency at 12th grade (U.S. Department of Education, 2003). It is clear that too many students, not only those categorized as special, are struggling readers, are ill-equipped to deal with differing types of material, and are equally unprepared for the complexity of the material they will encounter (Snow, 2002). To improve results, students must alter how they read, implementing a new set of reading comprehension skills and strategies (Taylor, Pearson, Perterson, & Rodriguez 2001; Wilson & Rupley, 1997). This is most difficult for students because comprehension-strategy instruction is largely absent in high school classrooms (Pressley, 1998), and students are expected to understand and apply what they are assigned to read. If high school content educators continue to expect that their students have the required skills for understanding their content and if they continue to teach content in the same manner with limited attention to comprehension-strategy instruction, they will continue to get the same results. In CAST's work with high school teachers, we found that using the PAL process to design a curriculum that is guided by the UDL principles and drawn from research-based reading comprehension practices is effective in reducing learning barriers and building on all learners' strengths.

The PAL process (see Figure 1) provides teachers with practical steps that can be used in planning curricula that improve learning outcomes for all students. Before the actual PAL process begins, a PAL team is identified; the teams should include regular and special education teachers and other specialists who focus on the foundation of instruction—the curriculum. One member of the team is appointed team facilitator and is responsible for setting up regularly scheduled meetings, checking in with others to respond to questions, supporting the PAL process, and setting the agenda. Throughout the PAL process, each team member draws from his or her educational expertise and experiences to design a curriculum that ensures that all learners gain knowledge, skills, and enthusiasm for learning. Collaboration is a key ingredient among the team members, with all focusing on developing a flexible curriculum that supports all learners' achievement of identified goals.

Once the PAL team is identified and a facilitator is selected, the team formally begins the four-step PAL process that is based on the principles and concepts of UDL (Meyer & Rose, 2000; Rose & Meyer, 2002), proven professional development strategies (Darling-Hammond, 1999; Guskey, 2002), and effective teaching practices. Online resources and templates are available to the team to support the PAL process; however, once the team is familiar with the four-step process, it may not be necessary to use these resources.

Step 1: Set Goals

Setting goals that provide appropriate challenges for all students is the PAL team's first responsibility. Although it seems obvious, the team needs to understand what they want all students to learn and the aspects of the goals that must be held constant for all students. It is essential that the means for achieving the goal is separate from the goal itself. In setting goals, the team (a) establishes a context, providing background information regarding the content and topic for the lesson or unit, or (b) aligns goals to local content and state standards to ensure that all students have access to high quality curricula. The UDL Goal Setter (see Appendix A)

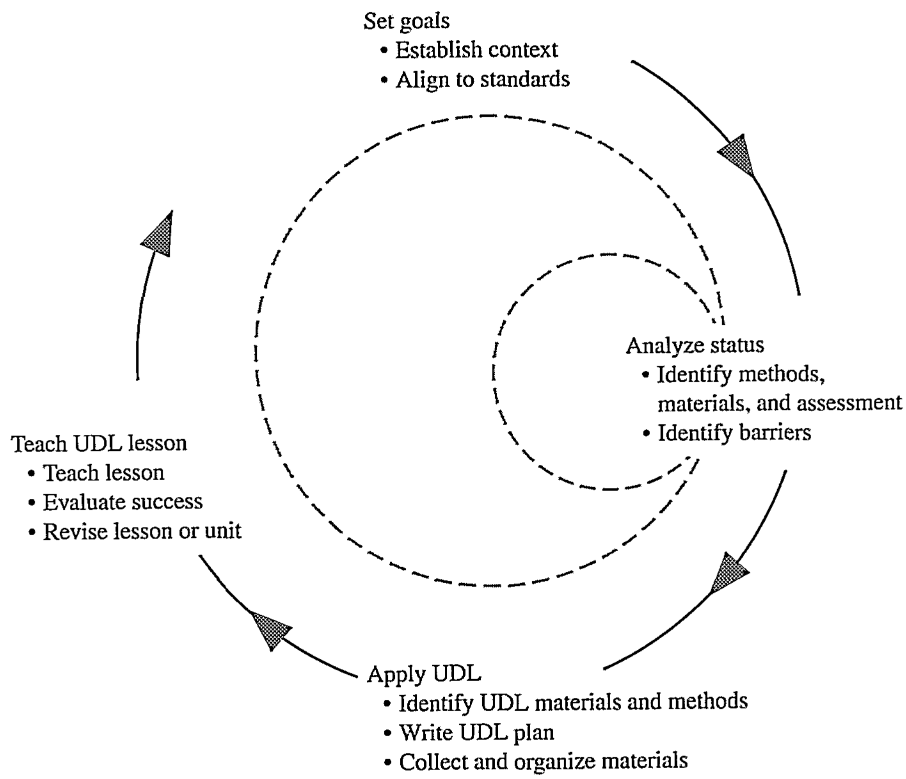

FIGURE 1. Planning for all learners (PAL), a process for developing and delivering lessons based on universal design for learning (UDL).

is an online resource that provides a tutorial and starter tool to help educators design clear goals (CAST, 2007a).

Step 2: Analyze Current Status of Curriculum and Classroom

The PAL team collects baseline information about currently used instructional methods, assessments, and materials and an understanding of the diverse nature of the students in the specific classroom. It is important that the team not focus on individual student profiles when designing lessons but rather understand that each classroom of students is diverse. In addition, this baseline information is necessary for identifying existing barriers in the curriculum that prevent access, participation, and progress for all learners. Identifying curricular barriers is a critical element of the PAL process because it is the role of the team to reduce and, if possible, eliminate barriers in the curriculum to ensure that all learners have the opportunity to succeed in the general education curriculum. To analyze current status, the team (a) identifies currently used methods, assessment, and materials to achieve goals, using the Lesson Analysis Template (CAST, 2007b); (b) develops and refines the class profile on the basis of diversity in the classroom, using the UDL Class Profile Maker (CAST, 2007c); and (c) identifies existing barriers in the curriculum that prevent access, participation, and progress, using the Curriculum Barriers with Assessment Form (CAST, 2007d).

Step 3: Apply UDL to Lesson or Unit Development

The PAL team, equipped with clearly defined curriculum goals and an understanding of currently used methods, assessments, materials, class profile, and potential barriers in the curriculum, applies the three core principles of UDL to the lesson or unit development. At this stage of the PAL process, the team (a) identifies methods, assessment, and materials that align with the UDL principles and lesson goals, addresses the diversity of the classroom, and eliminates potential barriers using the UDL Solutions Finder as a guide (CAST, 2007e); (b) writes a UDL lesson or unit plan using the UDL Lesson Planning Form (CAST, 2007f); and (c) collects and organizes materials that support the UDL lesson in preparation for teaching the lesson.

Step 4: Teach the UDL Lesson or Unit

To complete the PAL process, the UDL lesson or unit is taught to the class. It is recommended that the lesson is taught by a team of regular and special education teachers. The UDL lesson is planned to minimize curriculum barriers, realize the promise each student brings to learning, rely on effective teaching practices, and apply challenges appropriately for each learner. In this way, the lesson will engage more students and help each student make progress. If the lesson was successful for all students, the team begins the PAL process on a different lesson. If the lesson needs revising, the team revisits the PAL process and proceeds to refine the lesson to reduce barriers and make it accessible for all learners. It is important to note that no lesson works for all students and that the "universal" in UDL does not mean that one size fits all.

Connecting UDL to Classroom Practice

UDL is the framework for creating flexible goals, methods, materials, and assessments that accommodate learner differences. The PAL process, developed as an educator application of UDL, is a set of steps for designing curricula (goals, methods, materials, and assessments). From CAST's work with 12 high school content teachers and special educators, the following composite case story was developed to represent an 18-month professional development project designed to improve students' understanding of core curriculum content by bringing together principles of UDL (Hitchcock et al., 2002; Rose & Meyer, 2002), the PAL process, and research-based reading comprehension practices (Beck, McKeown, & Kucan, 2002; Palincsar & Brown, 1986; Pressley, 1998; Snow, 2002; Taylor et al., 2001; Wilson et al., 1997).

Meet Mr. Allen and His Class

Mr. Allen, a ninth grade social studies teacher, is concerned that his third-period world history students show little interest in class and have difficulty understanding the class textbook. Many of his students perform poorly on the end-of-the-chapter questions, and few students participate in class discussions. Mr. Allen has a heterogeneous class of 27 students—14 girls and 13 boys. His students represent diverse backgrounds, skills, experiences, and interests. He has 5 students who have identified disabilities and have an individualized education plan (IEP) and 11 students for whom English is not the primary language at home. He is increasingly aware that 9 students are struggling readers. Some students have jobs after school and some play after-school sports. Although Mr. Allen has the advantage of coteaching with a special educator—Ms. Jones—they face the challenge of figuring out how to teach the lessons so that all students reach the social studies goals and are interested in learning the world history content.

Mr. Allen volunteered to participate in the CAST project with the hope of learning new strategies for reaching all his students. He understood that the project focus was on improving reading comprehension skills for high school students by applying UDL and research-based practices to his content, and he admitted that he was neither familiar with UDL nor did he expect to have to teach reading skills to high school students. As he told one interviewer,

> I have my degree in history and a master's degree in education. I've never had an official reading course of any kind and even some of the terminology I've sometimes heard during my work with CAST, I'm like, 'I don't know what that means.' It's not something that's in my discipline. (teacher interview, 2005)

Mr. Allen was not unlike the other teachers in the CAST project in that they had limited or no understanding of UDL before the start of their work together and limited experiences in using research-based reading comprehension strategies with their students. This was true of both the regular education and special education teachers.

Project Goals

The primary goal of CAST's project work with the 12 participating teachers was to provide the teachers with strategies for designing curriculum to meet the needs of their diverse classrooms. Although the focus of this work was on the implementation of the PAL process for curriculum planning, the CAST members also provided the project participants with a foundation in the principles of UDL and empirically validated reading instructional practices, including the reciprocal teaching methods (Palincsar & Brown, 1986), robust vocabulary instruction (Beck et al., 2002), and use of concept maps to improve comprehension (Strangman, Hall, & Meyer, 2003). Although these research-validated reading comprehension strategies were key elements in achieving the overarching goal of increasing students' understanding of core curriculum content, in this article, I focus on participant experiences with the PAL process.

Identifying the PAL Team

Mr. Allen and Ms. Jones, a special educator and coteacher in high school social studies and English classes, made up the core PAL team. Mr. Allen was primarily responsible for the core curriculum content, and Ms. Jones was responsible for reinforcing needed skills for students who were falling behind. Ms. Jones took on the role of team facilitator, and she not only maintained momentum, scheduled meetings, and set the agenda, she also invited other specialists to PAL meetings on an as-needed basis. In contrast to Mr. Allen and Ms. Jones' team composition, other project participants formed PAL teams that included department faculty with participation from special education support staff and library media specialists. During the project work, it was observed that the Allen–Jones team found it easier to collaborate and engage in the PAL process on a regular basis, given that they had common planning time.

Step 1: Set Goals

Although Mr. Allen and Ms. Jones supported each other's efforts in the classroom, they usually worked on different goals for different students. For example, Mr. Allen typically aligned his curriculum goals to the local and state standards, and Ms. Jones noted that she focused on organizational skills regardless of the content. Given their working relationship and the clear line of responsibilities, it was first necessary to encourage Mr. Allen and Ms. Jones to work together as a curriculum planning team and to jointly identify the social studies goals that they wanted all students to achieve. Using the UDL Goal Setter and understanding that it was important to define goals that separated the means from the goal, the Allen–Jones team identified a social studies goal: "All students will understand the causes and impact of the Industrial Revolution and be able to demonstrate this understanding" (teacher interview, 2005).

Step 2: Analyze Current Status of Curriculum and Classroom

In teaching a lesson that focused on the defined goal of understanding the causes and impact of the Industrial Revolution, Mr. Allen typically used a text book as the primary resource, and he usually presented information about this topic in lecture format, followed by class discussions. In contrast, Ms. Jones either worked on organizational and study skills with those students on IEPs or spent time simplifying the presented concepts. Understanding of new content for students not identified as having special needs was generally measured by multiple-choice or essay tests at the end of a unit. In contrast, Ms. Jones typically designed new tests to measure her students' knowledge of the content and often gave her students these tests in a separate setting.

Students in Mr. Allen's class represent a broad diversity of strengths, challenges, preferences, needs, abilities, and experiences. Given the traditional methods, materials, and assessments that he used, it is obvious that there are many barriers that prevent all of Mr. Allen's students from achieving his social studies goal. Mr. Allen and Ms. Jones used the Curriculum Barriers with Assessment Form as a guide to identifying existent barriers. They realized that the textbook was a barrier not only for the students with decoding problems but also for English language learners. In addition, they noted that some typically achieving students were not successful on the multiple-choice tests even though they contributed to class discussions. They also found that for some students, writing cohesive sentences in response to an essay test was a barrier, and for many students, the class discussion was conducive to discussion. Overall, Mr. Allen and Ms. Jones as a PAL team began to understand that it was important to identify potential barriers and then eliminate them to increase opportunities for all learners.

Step 3: Apply UDL to Lesson or Unit Development

With clear social studies goals, an understanding of potential and real curriculum barriers, and recognition of the class diversity, Mr. Allen and Ms. Jones as a PAL team were prepared to identify methods, materials, and assessments that would lead to successful learning outcomes for all students. The following sections present some highlights from the work with Mr. Allen and Ms. Jones.

Method. In CAST's PAL project that is guided by UDL principles, we pointed out to the teams that no one method is effective for reaching all learners. Therefore, no matter how engaging Mr. Allen's lecture might be for some students, it will not work for others. Consequently, CAST members reinforced that it is important to provide multiple representations and multiple formats for learning new ideas and concepts. Mr. Allen and Ms. Jones decided to begin the new unit on the Industrial Revolution with a brainstorm activity, using Inspiration software (Strangman, Hall, & Meyer, 2003) to activate students' background knowledge (Strangman, Hall, & Meyer, 2004). Both practices (i.e., the use of concept maps and activating prior knowledge) have been shown to have positive impact on improving student learning (Strangman et al., 2003, 2004). In addition, Mr. Allen and Ms. Jones incorporated their new understandings of the core concepts of reciprocal teaching strategies (Palincsar & Brown, 1986) and robust vocabulary instruction (Beck, McKeown, & Kucan, 2002) into their lessons. Mr. Allen immediately saw the benefit of applying the reciprocal teaching strategies of clarification, prediction, summarization, and questioning to his content.

Materials. Realizing that the textbook was a barrier for some of his students, Mr. Allen saw the benefit of scanning sections of the text so that it could be read by the computer for students with decoding problems. He also realized that he needed additional materials that were more engaging for his students. Therefore, the PAL team began searching the Internet for relevant materials, knowing that the computer could read anything in digital form. Both teachers were pleased with their planning process because they saw how alternative representations of the information would benefit not only students with disabilities but also English language learners and students who needed options to keep them engaged. They also found low-tech strategies, such as using strategy stickies in a book to help students pause and think about what they were reading, and high-tech strategies, such as using Microsoft Word's insert text or audio comment features, to be effective in providing varied means of supporting understanding (see Appendix B).

Assessment. Mr. Allen and Ms. Jones understood the need to offer options in assessing students' understanding of the causes and impact of Industrial Revolution. In addition to multiple-choice and essay tests, students were given choices for demonstrating understanding; these included performing an enactment with a team, developing a multimedia presentation, writing a book for another grade level, writing a poem, or conducting a research project. They realized that one method of assessment is not appropriate for all students, and they found that when they provided choices, more students were interested in demonstrating their new understanding.

Step 4: Teach the UDL Lesson or Unit

Mr. Allen and Ms. Jones jointly taught the PAL lessons, focusing on understanding and impact of the Industrial Revolution. If all students demonstrated understanding of the concepts, they began the PAL process again for a new lesson. If students had difficulties, Mr. Allen and Ms. Jones revisited the lesson and revised it as needed.

Project Highlights

Mr. Allen was not atypical of the other project participants in that there were several noted changes in his practice as a result of his new understandings. For instance, in the initial focus-group session, Mr. Allen noted that he typically tended to blame students' lack of preparation, background, or personal limitations for their failing in his classes. By the end of the project, Mr. Allen and his peers realized that the inherent barriers in their curriculum were the problem and that the curriculum needed to be designed to eliminate barriers and increase options for learning (see Appendix C).

Another relevant finding is the benefit of joint-curriculum planning when the regular education teacher and special education teacher focus on the curriculum. This was clearly evident in the work of Mr. Allen and Ms. Jones as they came to appreciate their unique contributions to the process of planning a curriculum. In addition, the change in understanding and the use of research-based practices in classroom instruction were noticeable across all participants. By the final focus group, Mr. Allen and his peers had adopted language that reflected the concepts they had learned to support students' reading for meaning during the project. More important than their adoption of the program's language, however, was their growing adoption of UDL principles and effective strategies in their teaching.

Summary

By incorporating the three principles of UDL into curriculum planning, teachers increase their ability to customize their curricula (goals, methods, materials, and assessment) to meet the needs of the diverse learners in their classes. Similarly, to support students' understanding of content, it is recommended that teachers explicitly teach and apply effective comprehension strategies within the context of teaching the content and that the methods of instruction be guided by the UDL principles.

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APPENDIX A
The Universal Design for Learning (UDL) Goal Setter

Growing diversity in today's classrooms increases the need for teachers to individualize instruction. At the same time, heightened concern about student achievement mandates that teachers meet specific local, state, and national standards. These two factors—learning standards and student diversity—seem to pose conflicting priorities. How can teachers set goals that address standards while supporting the unique propensities of each learner?

The key is to design a goal that represents the true purpose of the learning activity. This sounds obvious, but many goals are actually stated in a way that confuses means and ends. Only when the essential learning purpose is clear can instructors determine the educational focus for all learners. At the same time, a clear goal enables us to determine which alternative pathways and scaffolds can be used to meet diverse learning needs while keeping the learning challenge where it belongs.

The UDL Goal Setter can help you achieve this. It has two parts:

1. The UDL Goal Setter Tutorial walks you through the process of analyzing learning standards and benchmarks through the lens of UDL. Using a selected set of standards and benchmarks, the tutorial helps you learn to analyze what is essential to a goal and what can be changed to support different learners.
2. The UDL Goal Setter Tool supports you in refining your own goals for use in the classroom.

To access the UDL Goal Setter Tutorial and Tool, visit http://www.cast.org/teachingeverystudent/tools/udlgoalsetter.cfm.

APPENDIX B
Additional Resources For Understanding and Applying Universal Design for Learning (UDL)

General information

What is UDL?
For text: http://www.cast.org/research/udl/index.html
For video: http://lessonbuilder.cast.org/window.php?src=videos

Frequently asked questions
http://www.cast.org/research/faq/index.html

UDL resources
http://www.k8accesscenter.org/index.php/category/universal-design

Books

Teaching Every Student in the Digital Age: Universal Design for Learning (2002). By David H. Rose and Anne Meyer. Alexandria, VA: Association for Supervision and Curriculum Development.
For full-text digital edition: http://www.cast.org/teachingeverystudent/ideas/tes
For audio (MP3) overview: http://www.cast.org/audio/TESpodcast.mp3
For multiresource Web site: http://www.cast.org/teachingeverystudent

The Universally Designed Classroom: Accessible Curriculum and Digital Technologies (2005). Edited by David H. Rose, Anne Meyer, and Chuck Hitchcock. Cambridge, MA: Harvard Education Press.

A Practical Reader in Universal Design for Learning (2006). Edited by David H. Rose and Anne Meyer. Cambridge, MA: Harvard Education Press.

Teacher resources and professional development

UDL Tool kits: This free online resource helps educators create UDL-based lessons, apply UDL principles in classrooms, or train others in UDL.
http://www.cast.org/teachingeverystudent/toolkits/tk_introduction.cfm?tk_id=61

UDL Lesson Builder: This free online resource helps educators create UDL-based lessons.
http://lessonbuilder.cast.org

UDL Book Builder: This free online resource helps educators develop digital books with rich learning supports.
http://bookbuilder.cast.org

UDL training: Some Web sites provide information on UDL professional development.
CAST: http://www.cast.org/pd/index.html
Harvard University: http://www.gse.harvard.edu/ppe/k12/programs/ude.html
Don Johnston, Inc.: http://www.donjohnston.com/prof_services/UDL.html

Learning Through Listening Web site: Recording for the Blind and Dyslexic (RFB&D) and CAST present teacher resources with a special emphasis on lesson plans and audio resources.
http://www.learningthroughlistening.org

APPENDIX C
Universal Design for Learning (UDL) Planning for All Learners Checklist

Question	Yes or No?
Did you identify clear goals that separated the means from the goal?	
Did you eliminate barriers from the methods, materials, and assessments?	
Did you plan or design your lesson thinking about multiple means of representing the concepts and new ideas?	
Did you plan or design your lesson thinking about multiple ways to express and support student understanding?	
Did you plan or design your lesson thinking about multiple ways to engage your students?	

Accessibility in post secondary education: Application of UDL to college curriculum

Darra Pace, Diane Schwartz
(CRSR Department, Hofstra University, New York 11549, USA)

Abstract: The inclusion of students with disabilities at the university is a relatively new occurrence in the field of special education. Although legislation in the United States has supported the acceptance of students with disabilities at the post-secondary level, it has only provided minimal support with the emphasis on the learner rather than the curriculum. Now we are looking for multiple ways for students to access learning and demonstrate mastery. Universal Design for Learning (UDL) is currently seen as a means to reconceptionalize curriculum. This study examines the experience of four professors and their effort to use a Classroom Performance System (CPS) as part of reformatting their courses using UDL. The Center for Applied Special Technology, CAST (2001) states that the goal of Universal Design for Learning is to develop teaching methods that enable all students with diverse learning needs, including those with disabilities and cultural differences, to have equal access to classroom curriculum. This paradigm shift echoes the move in special education from a deficit model to a minority rights model put forward by Hahn (1989), and which is the basis of inclusive educational philosophy. Together inclusion and UDL create learning environments that strive to serve all students. This research describes the implementation of clickers as part of the CPS program in college courses in a special education teacher preparation program. The case study demonstrates how technology can provide access for all learners with positive outcomes such as increased participation and application of knowledge. It also illustrates some of the difficulties in making this pedagogical paradigm shift particularly in the use of technology, and the value of overcoming the existing barriers in place.

Key words: teacher education; technology; Universal Design for Learning; curriculum; diversity; students with disabilities; inclusion

1. Introduction

The history of universities and colleges and students with disabilities is a rather recent one. Student attendance at institutions of higher education is a direct mirror of the dispositions of society in regard to individuals with disabilities. When looking back at society in the nineteenth and early twentieth century the dominance of the Eugenics movement demonstrates a social response of rejection and isolation of those with disabilities not one of acceptance and opportunity. Although special education traces its beginning to the late

Darra Pace, Ed.D., associate professor, CRSR Department, Hofstra University; research fields: UDL, cognitive disabilities and response to intervention (RtI).
Diane Schwartz, Ed.D., associate professor, CRSR Department, Hofstra University; research fields: young children with disabilities and their families, UDL and inclusive schooling.

eighteenth century and Itard and his work with Victor *The Wild Boy of Avignon*, the idea of post-secondary education is relatively new. Sequin started schools for students with disabilities in the US in the mid-nineteenth century. It took approximately one hundred years for a program to be established at the college level. In 1945 the University of Illinois started the first support program in the states for the individuals with disabilities.

Legislation in the United States also supported the acceptance of students with disabilities at the post-secondary level, particularly section 504 of the Rehabilitation Act of 1973, the American with Disabilities Act of 1990, and the Higher Education Act of 1965. Colleges and universities offered the individuals with disabilities support through programs that arranged for accommodations for the coursework and examinations that the students took as part of their degree programs. As in the public schools the supports were add-ons to the traditional curriculum. The emphasis was on fixing the learner rather than the curriculum. Now we look for multiple ways for students to access learning and demonstrate mastery. Universal Design for Learning (UDL) is currently seen as a means to reconceptionalize curriculum.

The Center for Applied Special Technology (CAST, 2001) states that the goal of Universal Design for Learning is to develop teaching methods that enable all students with diverse learning needs, including those with disabilities and cultural differences, to have equal access to classroom curriculum. A major concern of practitioners of UDL is the creation of classes with equity and inclusion at the core of the learning environment (Pliner & Johnson, 2004). This paradigm shift echoes the move in special education from a deficit model to a minority rights model put forward by Hahn (1989), and which is the basis of inclusive educational philosophy. Together inclusion and Universal Design for Learning, create learning environments that strive to serve all students.

2. Definition of UDL

According to Rose and Meyer (2002), Universal Design for Learning (UDL) applies the idea of the architectural concept of Universal Design in which buildings are made to be accessible to the widest range of users (Mace, 1985). Universal Design for Learning makes access to curriculum for diverse learners a primary goal. This new found accessibility to curriculum is beneficial to all students not only those with disabilities. For example, closed captioning, which was initially designed to accommodate individuals with hearing impairments, has been found to also benefit students who need a multi-modality approach when learning.

In education, UDL translates into creating flexible curriculum, so it is accessible to a wide group of diverse students, while also increasing access to learning for everyone. Rose and Meyer (2002, p. 75), go on to explain the three principles of UDL which are its framework.

(1) Principle 1: To support recognition learning, provide multiple, flexible methods of presentation.

(2) Principle 2: To support strategic learning, provide multiple, flexible methods of expression and apprenticeship.

(3) Principle 3: To support affective learning, provide multiple, flexible options for engagement.

The unifying thread that runs through the above principles is that of giving students different options in order to learn. While this removes barriers to learning for some students, it also gives typical students more and varied learning opportunities. At the same time, UDL is compatible with modern pedagogical theories. This approach to curriculum does not remove academic challenges (Izzo & Murray, 2003). It provides a wide range of "best practices" that a professor can use to facilitate the learning of all the students in the class.

3. Application of UDL in the classroom

The true test of the UDL paradigm is the application and effectiveness in the classroom at the university. Traditionally a college course in the United States has been a "one size fits all model" in which "too often faculty assume that their methods of delivery are synonymous with the students' achievement of course goals" (Pliner & Johnson, 2004). Typically a professor determines the objectives and outcomes of the course, assigns readings, designs lectures and discussions, and decides on the means of assessment of the knowledge presented. This information is distributed to the students in the form of a written syllabus with each student expected to meet the requirements as stated. The professor's focus is on the knowledge to be imparted not necessarily how students can or cannot access that information.

Today the American student population is one of diversity, not only culturally, racially, but also linguistically. It is estimated that by the year 2050 nearly one quarter of the US population will be Hispanic (2005). In addition, the move to inclusive schooling as mandated by IDEA 1997 and reauthorized as IDEIA 2004, has transformed our classrooms at all levels of the educational process. IDEA has helped to expand the educational horizons of students with disabilities who previously would not have attended institutions of higher education. Now the college classroom reflects not only cultural diversity but diverse learning needs. Therefore the "one size fits all" approach is no longer tenable.

In addition to redefining the delivery model of instruction, UDL seeks to move students from what Friere (1993) describes as the banking system of education where information is deposited into passive students. Universal Design for Learning also promotes "active learning" which is one of the widely acclaimed "seven principles for good practice in undergraduate education" by Chickering and Gamson (2007). UDL fosters greater in class participation in various ways. Specifically the use of clickers and group presentations actively engage students in the curriculum.

4. Classroom Performance System (CPS)

This research looks at four university professors and their individual experiences with incorporating a Classroom Performance System (CPS) into their instruction in an attempt to make their courses more accessible and engaging. CPS is a software that includes response pads or clickers, and receivers with radio frequency technology, to enable students to interact with the content material that is presented in class. Questions can be imported in a PowerPoint presentation and with CPS students responses can be identified or submitted anonymously.

At our university, faculty have the means to present all course materials electronically using an application platform called blackboard. This technology allows professors to link course reading to electronic reserves that students can access on their own computers thereby enabling them to alter text fonts and size to make them more usable. Students can preview class lecture by reviewing the professors PowerPoint presentations and can engage in discussions with their classmates through various discussion boards. Contact between students and faculty via email increases the ability of students to raise questions, receive feedback and clarification regarding assignments and reading in between class meetings. This technology makes the course content available to the students through the use of the computer, eliminating a number of barriers. The four professors in this study had used the blackboard format extensively. In a step toward more active and interactive learning while expanding access and engagement with curriculum, the decision was made including CPS in the coursework.

5. Research design

This research employed a case study designing to examine the use of CPS in graduate courses by four university professors. Case study can involve one or multiple cases, multiple cases being a variation on the case study format, while essentially the same research strategy (YIN, 2004). The use of case study was appropriate to this research since it described an intervention in a real life situation, explored specific topics relevant to the research, while highlighting aspects of particular importance (YIN, 2004). As Schramm (1971) explains the case study format lends itself to the examination, implementation, and outcome of a decision. In this study, case study allowed the researchers to look at the cause and effect of the decision to implement CPS in graduate courses.

5.1 The instrument

A survey was given to the four professors who used CPS in their courses. It consisted of four open-ended questions that covered various aspects of the use of clickers: reason for implementation of clickers, ease of integration, student response and overall teacher evaluation.

Participants' demographic data were also collected on the survey including years of teaching and self-assessment of technological ability.

5.2 The participants

All four participants were female professors in the special education teacher preparation program. They ranged in age from forty-five to sixty-four. They had worked at the university for between two and eighteen years, two were tenured and two were not. Each had a different level of technological acumen with two younger professors describing a higher degree of knowledge and comfort.

5.3 The procedure

Each of the participants volunteered to incorporate the use of the CPS system in one of the courses they taught during the spring 2008 semester. The technology staff at the university provided training in the correct use and implementation of CPS. The professors reworked traditional PowerPoint presentations used in classes by embedding response questions to enable the students to use their clickers to further engage in the content material.

The courses selected for the pilot varied. Four different types of graduate classes were involved including a foundation course, a technology course, a methods course and a behavior management course. Students were required to purchase the clickers and register them for the classes in which they were used. They were asked to bring the clickers to each class.

After using CPS for one semester, the four professors in the study evaluated the experience. Surveys were distributed to the group and once completed were returned to the researchers.

6. Data analysis and results

In looking at the demographic data collected, it should be noted that the level of proficiency in using technology varied amongst the professors from very skilled to adequate. Although the level of expertise in technology varied, all participants used it in class instruction. As part of a UDL designed course the technology allowed students to preview class presentations, provided an outline of class notes, allowed review for examinations, and enabled access to readings on line.

Question one asked the participants to explain why they decided to incorporate CPS into their class instruction. All four professors expressed interest in the clickers because it seemed to be a way to actively engage all students in class discussion and to encourage students who usually never participate (there seems to always be one or two in each class) to express their opinions. It was felt that the clickers would enable students to risk responding anonymously without performance anxiety or embarrassment.

In question two, the participants were asked to describe the ease with which CPS integrated with the established instructional format. While the professors were extremely enthusiastic about using clickers they found the ease, with which this technology was integrated into class very difficult with multiple failures initially.

Specifically:

(1) The steps and procedures for implementation were very complex and for one professor who used a Mac the steps were even more complicated;

(2) Log in time was found to be so long that it delayed class time;

(3) In some instances computer support was not able to solve initial problems;

(4) The professors were unable to use the university computers or network to run CPS presentations for use of the clickers;

(5) Technical issues slowed down the process;

(6) Some hardware was not caught up with the software.

Question three asked participants to report on their perceptions of student reaction to the use of CPS in their coursework. Professors described their students' responses to the clicker experiment as mixed. Most students balked at the additional expense of purchasing and registering the clickers. Although they complained when things didn't work, students also expressed great excitement when the professors finally got the clickers to function. One student mentioned how the integrated questions raised the level of discussions allowing the class to actively participate in the material rather than being passive recipients of a lecture. Students were pleased when they found out they could resell the clickers to the bookstore after the course was over, minimizing the expense. However, many students expressed frustration with the technical problems which disrupted the class flow and wasted instructional time.

The last question asked the participants to make an overall evaluation of the clicker experiment. All four professors concurred that it was worth the effort and that they plan to use clickers in the future. Clickers were considered to be an effective tool for engaging all students, and increasing the number of pupils who completed reading assignments. The educators also saw the potential in using CPS for other valuable applications. However all felt that more technological support was needed to address the various glitches encountered with the new program.

7. Discussion

The Universal Design for Learning format fosters an educational shift from looking at how to accommodate one student to rethinking curriculum to meet the needs of all students in the class (Rose & Meyer, 2002). All the participants in this case study had incorporated technology into their class instruction previously. The use of the blackboard platform expanded the flexibility of class presentations, allowing student access to materials that they were able to review and modify using the computer. Teacher use of this technology altered presentation and generally involved a move from use of an overhead projector to the use of PowerPoint. Although access was increased, the question of curriculum design was not really considered. When integrating CPS in order to increase student engagement and to monitor student progress, professors needed to make sure that the material being presented was accessible. Teachers were required to look at the learning process rather than solely focusing on course content. This translated into using embedded questions that were meaningful to each student regardless of their ability. Flexible engagement through the use of clickers resulted in full participation in class discourse. Teachers and students reported that when the clickers worked, the level of engagement and the type of discussion increased in both depth and application of knowledge. Because of this all the professors involved in the study wish to continue the use of CPS, regardless of the technological challenges encountered.

The participants reported a number of barriers to implementation of the clickers in the classroom. Primarily the difficulties arose in the areas of the condition of technology hardware and the availability of technological support. Rose and Meyer (2002, p. 161), identify key components of UDL implementation. The first of these components is technology infrastructure and support. They state that "without technological support UDL is just an impracticable theory". Unfortunately, the participants in this study report insufficient technology support. Training was limited and the availability of technicians was lacking. All of which combined to result in a high level of frustration on the part of both the teachers and students. One professor spoke of the increased numbers of steps to use CPS with her Mac since the program was PC oriented. Another participant reported that the program could not be used with the university computer network, and required the use of a personal computer. The university hardware had not kept up with the newest software.

The professors said that the most trying aspect of the use of the clickers was the toll taken on class time. All of the technological issues including an extended wait time for the loading of the program resulted in delays and disruption in the flow of the class. The solving of the technological problems is essential to the incorporation of CPS and the extension of the UDL format. All of the professors said that they hoped that the issues would be addressed and that the system would be able to be blended seamlessly into the class lectures and discussion. They were optimistic and intended to continue to use the clickers since they were dedicated to moving to a UDL model in their classes.

Although the survey did not focus on evaluation, the participants related the unanticipated benefit of formative assessment. Because students were able to respond anonymously, CPS provided a window into the students' learning process. Professors gleaned an authentic assessment of student learning by interpreting clicker responses. This is in sharp contrast to traditional assessments that measure performance summatively and reveals little about student formative learning. As a result of using CPS, teachers were able to redirect their instruction.

8. Conclusion

Even in a university such as ours with a long history of support for individuals with disabilities through accessibility, the movement toward redesigning curriculum is only first emerging. Universal Design for Learning reconstructs curriculum in a way that makes it accessible to all learners, and therefore is integral to an inclusive educational environment. Professors at the university are beginning to rethink how they teach and who they are instructing. UDL is a perfect model for them to follow to enable all their students to access to the knowledge and skills presented in their courses.

Rose and Meyer (2002) stress the practicality of the UDL framework in using technology to maximize learning opportunities and minimize barriers for all students. In today's digital age, educators can avail themselves of technology which supports learners as needed while insuring that they are challenged appropriately. This study demonstrates the effort to implement UDL within the context of higher education classes. The findings of this case study illustrate the challenges inherent in moving to a UDL model. It also highlights the benefits and potential of using programs such as CPS at the post secondary level. This research reinforces Rose and Meyer's (2002) statement that adopting UDL wholesale is not possible. It is not simply a question of one teacher applying the format in one class. But rather to make UDL a reality there must be a commitment of the learning organization to systemic change. This is evidenced by making sure that the technology in place supports the change, along with adequate teacher training, curriculum redesign, and a policy that is dedicated to UDL.

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Gaining Access to General Education: The Promise of Universal Design for Learning

Terese C. Jiménez, Victoria L. Graf, & Ernest Rose
Loyola Marymount University

On November 29, 1975 then President Ford signed the *Education of All Handicapped Children Act* (EAHCA, Public Law 94-142) into law, mandating for the first time that children and youth with disabilities be afforded the right to a free and appropriate public education, individualized programming, parental participation in the decision making process, nondiscriminatory identification and evaluation, instruction in the least restrictive environment, while ensuring families due process rights and responsibilities. A little over thirty years have passed since the commencement of this important special education legislation with additional changes to the law and the manner in which we educate and support students with disabilities and their families. Many researchers and practitioners have documented both the accomplishments and challenges brought forth during the law's first three decades of implementation (Jiménez & Graf, in press).

One such challenge has been ensuring adequate access to the general education curriculum for an increasingly diverse group of learners within general education classrooms. As teacher educators and researchers in the field of special education, we recognize the need to prepare general and special educators to meet the needs of students with disabilities, those at-risk for academic failure, and learners from diverse cultural, linguistic, and socioeconomic backgrounds (Grenot-Scheyer, Coots, &

Terese C. Jiménez, Victoria L. Graf, and Ernest Rose are professors in the School of Education at Loyola Marymount University.

Bishop-Smith, 2004). One approach to making general education curriculum more accessible to diverse learners regardless of ability, learning style, language, or culture is the application of Universal Design for Learning (UDL). "Grounded in research of learner differences, the capacities of new media, and the most effective teaching practices and assessments, UDL provides a framework for creating more robust learning opportunities for everyone" (Rose & Meyer, 2006, p. viii). By using a UDL approach in the classroom, teachers design their instruction to meet the needs of a diverse group of learners rather than make ongoing adjustments for individual students with special needs (Pisha & Coyne, 2001).

Highlighting the importance of UDL as a fundamental instructional approach has the potential to benefit students and teachers in both general and special education programs. For this special issue, we review the historical background regarding the movement toward greater access for students with special learning needs, the development of Universal Design for Learning as a method for providing access, and discuss supporting the implementation of UDL within school sites and institutions of higher education.

Toward Greater Accessibility

One of the hallmarks of P.L. 94-142 was the provision of least restrictive environment (LRE) requiring that states establish necessary "...procedures to assure that, to the maximum extent appropriate, handicapped children...are educated with children who are not handicapped" (20 U.S.C. 1412(5) (B).

The law defined LRE as the setting where students with disabilities receive special education services and experience the greatest success toward progress. Depending on the needs and goals of the student, LRE included placements falling along a continuum from least to most restrictive (e.g., general education classroom, resource room, separate special education school site) (Friend, 2005).

In the 1990s as Congress prepared for the next reauthorization of P.L. 94-142, its members reviewed research demonstrating higher performance by students with disabilities when provided greater access to general education curriculum. As a result, committee members inserted explicit language in the law supporting greater access to general education programs. The law's reauthorization in 1997, renamed the *Individuals with Disabilities Education Act* (IDEA), reflected these growing sentiments regarding greater accessibility: "Over 20 years of research and experience has demonstrated that the education of students with disabilities can be made more effective by having high expectations for such children and ensuring their access in the general curriculum..." (20 U.S.C. §1400 (c)(5)(a)(1997)). The most recent reauthorization of the IDEA (2004) maintains much of this same language but extends these ideas by requesting explicitly that access to the "general education curriculum" occur "...in the regular classroom, to the maximum extent possible" (20 U.S.C. § 1400 (c)(5)(2004)). Now more than previously, IDEIA 2004 calls for students with disabilities to have access to general education curriculum within general education classrooms as the most appropriate method of providing special services within the least restrictive environment (Karger, 2005).

In 2001, Congress passed the *No Child Left Behind Act* (NCLB), which required that all children, including those with disabilities, attain proficiency on state achievement standards and assessments (20 U.S.C. § 6301). Such legislative and policy efforts increasingly require teachers to make the curriculum accessible, allow students to be actively involved with the curriculum, and monitor students' progress (Hitchcock, Meyers, Rose, & Jackson, 2002; Karger, 2005). Exactly "where" a student with a disability should be educated is no longer the most relevant question. These developments have contributed to a fundamental shift in schools' education of students with disabilities and their access to general education.

As a result of the law's increasing emphasis for more inclusive experiences for students with disabilities, more students receive special education services within general education settings than ever before. In the U.S. in 2005, approximately 54% of students receiving special education services spent 80% or more of their day in a regular classroom (U.S. Department of Education, 2006). These numbers include not only students with high incidence, mild to moderate disabilities (e.g., learning disabilities, speech and language disorders) but also students with more severe cognitive impairments. Over the last decade, accessing the general curriculum for students with severe disabilities has become a major focus of researchers developing more effective educational approaches for these students (Spooner, Dymond, Smith, & Kennedy, 2006).

However, merely providing students with disabilities access to general education programs does not ensure their full acceptance within these settings or guarantee meaningful participation or comparable outcomes (Artiles, 2003; Wehmeyer, 2006). State and federal policy makers have increasingly imposed tremendous challenges on schools to implement numerous initiatives (e.g., No Child Left Behind), educational standards, and high stakes testing, making it more difficult for students with special needs to function adequately within general education settings. General educators often feel ill-equipped to appropriately address the needs of students with disabilities and prepare them for higher standards and expectations (Schumm & Vaughn, 1995). Doing so may require more specialized instruction than they are willing or able to provide (Artiles, 2003; Mclaughlin & Tilstone, 1999).

Furthermore, over the last three decades, students in need of additional assistance in the general education classroom include those who are learning necessary academic content in a language they are only beginning to acquire. Of those students who currently receive special services, 54% come from a variety of ethnically and linguistically diverse backgrounds (U.S. Department of Education, 2004). Projected estimates for our general school population indicate that by 2030, 43% of all students will speak English as a second language (USDOE & NICHD, 2004). An increasing number of students with diverse learning and linguistic backgrounds must learn core curricula and meet set educational standards with limited literacy and language skills to read standard classroom textbooks and communicate effectively about what they know.

To adequately address these legislative changes, educational policies and the changing landscape of our school population, all teachers must learn to design unique instructional programs that actively support learners with and without disabilities. We must move beyond discussions regarding inclusive instruction for students with special needs toward educational programs and methods that address the learning needs and skills of all learners. Universal Design for Learning shifts the focus toward appropriate instruction for "all" learners rather than those with special needs exclusively. The following section provides an introduction to UDL, its origins, and components.

Advent of Universal Design for Learning

Ronald Mace, an architect and director of the Center for Universal Design at North Carolina State University, first coined the term Universal Design to refer to the concept of simplifying life for everyone by making products, communication systems, and the "built environment" more usable by more people at little or no extra cost (Bowe, 2000). A working group of individuals at the center (product designers, engineers, architects, etc.) developed seven guiding principles[1] (Center for Universal Design, 1997) for the purpose of incorporating inclusive design features in new products and the general environment (McGuire, Scott, & Shaw, 2006). Examples of such products and environmental features include closed captioning on television sets (for individuals who are hard of hearing and airport passengers viewing television in noisy surroundings), and curb cuts (for individuals who use wheelchairs, baby strollers, dollies, and roller skates) (McGuire, Scott, & Shaw, 2006).

In 1984, David Rose and Ann Meyer co-founded the Center for Applied Special Technology (CAST) and began to define and extend the principles of UD to the learning environment (Rose & Meyer, 2000, 2002). The CAST staff has used technology as a primary resource to make classrooms, instruction, and curricula more universal. They have defined the principles for Universal Design for Learning (UDL) as providing students with multiple means of representation, expression, and engagement in the classroom (Rose & Meyer, 2000, 2002, 2006). When applied, these principles can assist teachers to "...recognize barriers to learning, strategically address such barriers, and monitor student progress" (Coyne, Ganley, Hall, Meo, Murray & Gordon, 2006, p. 1) within the curriculum. Providing students with multiple means of representation supports recognition learning and gives learners various ways of acquiring information based on their individual learning style, experiences and background knowledge. A history teacher for instance, reviewing the Civil Rights Movement, may bring in speakers, show television footage, and/or discuss relevant current events. Instruction that provides students with *multiple means of expression* supports strategic learning and creates several alternatives for demonstrating what learners know. As a method of assessing knowledge of the solar system, a teacher may have students individually, in pairs or small groups create a poster, script a news conference, build a model, and/or develop a video or Powerpoint presentation on the topic. These methods provide viable alternatives for those learners who experience difficulty demonstrating this knowledge through more traditional means (e.g., writing a paper, completing a written examination) given limitations in grade-level writing and reading skills.

Teachers who create *multiple means of engagement* support affective learning by tapping into learners' interests and offering appropriate challenges to increase their motivation. For instance, a high school English teacher may use songs from the hip hop genre when introducing students to the concept of rhetorical devices (i.e. imagery, symbolism) in order to familiarize learners to these concepts and engage them in the process (Woodyard, in press). CAST developed these guiding principles based on Vygotsky's (1978) seminal work describing the Zone of Proximal Development (the range in which learning takes place), and recent advances in neuroscience research, mapping the way the brain processes information (Rose & Meyer, 2006). UDL therefore is not a single practice or method but a framework that encompasses several existing methods relevant to its principles for enhancing the learning process for diverse learners.

This framework requires teachers to change the way they view the teaching- learning process, and how they initially approach lesson planning and instruction for all learners. UDL anchors existing practices into a strong theoretical framework requiring teachers to *anticipate,* up front, in their instruction how activities and methods support multiple means of presentation, expression, and engagement. Through UDL, teachers develop appropriate goals designed to address the needs of a wide range of students and implement instructional methods responsive to individual differences (Rose & Meyer, 2002). UDL encompasses—or at least complements—existing and well-known instructional practices (e.g., reciprocal teaching, cooperative learning, differentiated instruction) (see Table 1 for examples) (Coyne et al., 2006). These practices support the principles of UDL which serves as an inclusive framework for these teaching methods. Rather than view it as another innovation or approach to learning teachers feel they must adopt, UDL trainers encourage teachers to plan their instruction with existing tools and methods that reinforce these principles while slowly accumulating new methods through ongoing training and support (Rose & Meyer, 2002).

Universal Design for Learning may sound to some like just good teaching practices. UDL, however, is a promising framework making more "...explicit what good teaching is" (Rose & Meyer, 2006, p. 35) in order to support inclusive educational experiences for students with and without disabilities. It provides a theoretical framework based on research related to how individuals learn best and in what context, integrating relevant methods of instruction. How then have states, districts and universities begun to adopt the framework of UDL within their instructional programs?

Supporting UDL Implementation

Facilitating Change

Universal Design for Learning has finally made center stage in the national world of education. Most recently in the reauthorization of IDEIA (2004), the law specifically supports the development and use of technology with UD features and the incorporation of UD concepts in the development of educational standards, assessments, curricula, and instructional methods to support the education of students with disabilities. However, "UDL has, in some ways, become a buzzword, a bandwagon easily jumped on, given its intuitive appeal" (McGuire, Scott, & Shaw, 2006, p. 171). If the principles of UDL have gained such significant recognition, why haven't more schools begun to genuinely

Table 1
Instructional Methods that Support/Conplement UDL Principles*

UDL Principles	Method & Definition	Literature
Multiple means of expression, presentation & engagement	*Differentiated Instruction* Definition: Differentiate content – what students learn; Process – how students learn; and Product – how students demonstrate their knowledge. Example: Teacher uses graphic organizers to scaffold students' writing when teaching them the process of writing a paragraph.	(Tomlinson, 2001)
Multiple means of expression & engagement	*Cooperative Learning* Definition: Students work together in small groups, tapping one another as sources for learning. Example: Small groups of students research a select planet and develop a short paper, model, and Powerpoint presentation.	(Wood, Algozzine, & Avett, 1993)
Multiple means of presentation & expression	*Reciprocal Teaching* Definition: Involves small group dialogues between teachers and students around text, reviewing comprehension strategies. Example: Students use Thinking Reader to read assigned text before participating in small group dialogues. Thinking Reader provides adjustable font size, hyperlinked definitions, text-to-audio capacity and computer assisted support to learn comprehension strategies.	(Palinscar, 1986; Palinscar & Brown, 1985; Rose & Meyer, 2002)
Multiple means of expression, presentation & engagement	*Thematic Teaching* Definition: Lesson instruction is centered on a particular theme that transcends various content areas. Example: As a science project, students conduct an archeological dig for dinosaur fossils in a local playground using tools and artifact recovery methods while studying the unit "Our Word Long Ago." Students write/draw about their experience and/or present an oral presentation.	(Eichinger & Downing, 2002)
Multiple means of presentation & engagement	*Community Based Instruction* Definition: Experiences within the community that apply concepts or skills learned in the classroom. Example: Students visit local hospital, police and fire departments when studying "Community Helpers."	(Schukar, 1997; Westling & Fox, 2000)

*Note. Each method can potentially reflect all three components of UDL to varying degrees.

adopt and implement this framework? Encouraging change in schools is often a difficult endeavor given various challenges including a lack of general capacity to initiate, develop and sustain change efforts (Fullan, 2003). Rose and Meyer (2002) address this issue by proposing both a bottom-up and top down approach to UDL implementation.

> In the world of education , bottom-up changes are driven by individual students, parents, teachers, and administrators effecting change in classrooms, teaching methods, homework practices, and curriculum materials. Equally important are top-down changes—systemic changes in educational policies, professional development methods, publishing practices, economic models, and the participation of professional and lay organizations. (pp. 157-158)

As an example of a bottom-up approach to school change, Rose and Meyer (2002) describe their work within the Concord, New Hampshire school system. Donna Palley, the district's special education coordinator, relied on a "grassroots approach," working with individual and small groups of teachers to help develop solutions to identified barriers in their classroom instruction. Parents provided the necessary encouragement to promote change at the classroom, school site and district levels. General education teachers working with special educators and other specialists helped to support a common agenda. As a result of their extensive work with the Concord school system Rose and Meyer (2002) identified seven components for school districts to follow when implementing UDL related to technology, administrative support, training, professional roles, collaboration, parent involvement and funding (see Table 2). It is essential for districts and schools to be thoughtful about their implementation of UDL and what it requires, if it is to be successful and not just another educational innovation.

Rose and Meyer (2002) attribute Concord's success also to top-down approaches to UDL implementation including Concord's ongoing collaboration with CAST. Other top-down approaches incorporate the extensive efforts of states like Kentucky, Louisiana, Ohio, Maryland and New York that encourage technology planning, teacher-education and material development supporting UDL implementation (Müller & Tschantz, 2003; Rose & Meyer, 2006). Presently, Kentucky supports UDL through the Kentucky Accessible Materials Consortium (KAMC), a partnership with the Department of Education and the University of Louisville; the Kentucky Accessible Materials Database (KAMD), a repository of accessible digital content materials; available text-to-speech software; online assessment development; and the UDL Model Schools Project (Ender, Kinney, Penrod, Bauder, & Simmons, 2007). Specifically, Kentucky's Model Schools Project is a partnership between the Kentucky Department of Education and the University of Louisville providing three year grants at $30,000 annually to six schools to develop

Table 2
The Concord Model: Key Components & Examples of UDL Implementation

Key Components	Examples
Technology Infrastructure and Support	Districts digitize materials and build collaboration between technology and educational specialists.
Administrative Support	School principals demonstrate buy-in by supporting release time for training and support.
Teacher Training and Support	Administrators and consultants listen to teachers and brainstorm solutions to identified barriers.
Redefined Roles for Special and Regular Education Teachers	Special educators assist students with and without disabilities.
Collaborative Curriculum Planning	Teachers work with consultants to reconsider curricular goals, and gather new tools and supports.
Parent and Community Involvement	Parents volunteer to support UDL within classrooms and school sites.
Creative Funding	Districts, schools, and teachers develop and submit grant proposals supporting UDL practices.

Note. Modified from Rose and Meyer (2002).

a school wide model program utilizing best practices of UDL principles across the general education curriculum (Ender et al., 2007). Similar collaborative, multiagency approaches may ensure more effective and sustainable UDL practices within our schools.

Postsecondary Implementation

As teacher-educators we are particularly interested in implementing UDL practices within our preparation of candidates seeking credentials as educational professionals in the schools. The Center on Postsecondary Education and Disability (CPED) at the University of Connecticut works toward understanding the design and delivery of appropriate instruction within postsecondary settings and the evaluation of student learning. CPED conducts workshops on helping college faculty apply Universal Design to the instructional design process (known as Universal Design for Instruction, UDI) (McGuire, Scott & Shaw, 2006). To ensure a deep penetration of UDI design and implementation among a critical mass of faculty, this project has established learning communities of faculty to create UDI features in course curricula in diverse postsecondary institutions. One of the primary features of the project is FacultyWare (http://facultyware.uconn.edu), a web-based resource for postsecondary faculty to use for designing their courses using UDI principles. We are encouraged by CPED's work, as well as CAST's and the Access Center's teacher and trainer resources (http://lessonbuilder.cast.org/ and http://www.k8accesscenter.org/index.php, respectively) that can support Universal Design practices within teacher preparation programs. We hope to engage in further discussions concerning these resources and methods with colleagues both within and outside of our institution.

Research within postsecondary settings is needed to determine effective ways to prepare K-12 teachers to actually implement a comprehensive UDL curriculum at the school and classroom level (McGuire, Scott, & Shaw, 2006; Spooner, Baker, Harris, Ahlgrim-Delzell, & Browder, 2007). In one experimental study, Spooner and colleagues examined the implementation of UDL components within the instructional plans of in-service and pre-service general and special education teachers across four university teacher-education courses. Researchers provided experimental group participants with one hour of instruction in UDL principles and how these principles apply to planning instructional lessons. At pretest, participants in both experimental and control groups were given a case study of a child with a disability describing the student's strengths, interests, and three general curricular goals. Researchers asked participants to create a lesson plan within a span of 20 minutes, focusing on one curricular area. Investigators provided a comparable, but novel case study at post-test. Lesson plans for both groups were scored according to the degree to which the student made the lesson accessible for all learners including the child with the disability. Students in the experimental group showed significant gains from pretest to posttest and outperformed their control group counterparts. These results indicate that with explicit instruction in preparation courses, pre-service and in-service educators can design more accessible lessons for all students including those with specific learning needs. However, more research in this area is needed specific to how teacher education programs can better prepare educational professionals to implement a UDL framework.

Final Thoughts

In order to create more UDL inspired programs, educators, parents, administrators, specialists, and institutions of higher education must work beyond artificially established program boundaries toward more collaborative relationships across programs (Downing, 2006). Universities often set the tone for what teachers and other education professionals experience in the schools, an environment of unambiguous division (e.g., general versus special education) and seemingly privileged knowledge (e.g., administration, school psychology, counseling) without necessarily sharing a single approach to educating students (Jiménez, 2006).

We cannot expect teachers and school professionals to change the way they provide instruction and collaborate without expecting universities to change the way they prepare educational professionals in the field (Jiménez, 2006). Universal Design for Learning, through technology and pedagogical strategies, provides a unifying framework that encompasses many of the approaches we already address in our K-12 schools and professional preparation courses. We encourage institutions of higher education to collaborate across programs and systematically and explicitly introduce the concept of Universal Design for Learning as a viable framework upon which to build. We by no means have found the answers to these larger issues facing institutions of higher education and school districts across the nation, however, we felt this special issue provided us with a formal platform upon which to recommend UDL as a very plausible and necessary alternative.

Note

[1] The Center for Universal Design developed seven principles for UD which include: 1. Equitable Use, 2. Flexibility in Use, 3. Simple and Intuitive, 4. Perceptible Information, 5. Tolerance for Error, 6. Low Physical Effort, and 7. Size and Space for approach and use (Center for Universal Design, 1997).

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Effects of Training in Universal Design for Learning on Lesson Plan Development

FRED SPOONER, JOSHUA N. BAKER, AMBER A. HARRIS,
LYNN AHLGRIM-DELZELL, AND DIANE M. BROWDER

ABSTRACT

The effects of training in Universal Design for Learning (UDL) on lesson plan development of special and general educators in a college classroom environment were investigated. A true experimental group design with a control group was used for this study. A one-hour teacher training session introduced UDL to the experimental group; the control group received the intervention later. A three-factor analysis of variance with repeated measures was completed for each of the dependent variables (i.e., UDL lesson plan). Differences were found between pretest and posttest measures for both treatment groups for special education and general education teachers. The results suggest that a simple introduction to UDL can help teachers to design a lesson plan accessible for all students.

THE INDIVIDUALS WITH DISABILITIES EDUCATION Act (IDEA; 1997) and its most recent revision, the Individuals with Disabilities Education Improvement Act (IDEIA; 2004), have suggested that research has found that all students with disabilities must be held to high expectations and must be ensured access to the same general education curriculum taught to students without disabilities to the maximum extent possible. Yet *how* they have to access the general curriculum has been unclear, especially for students with significant disabilities (Browder et al., 2005). Throughout the past 2 decades, the field of special education has debated the pros and cons of including students with disabilities in general education classrooms (Huber, Rosenfeld, & Fiorello, 2001; McLeskey, Waldron, So, Swanson, & Loveland, 2001; Polloway & Bursuck, 1996). On the one hand, studies have shown that students with mild to moderate disabilities (Blum, Lipsett, & Yocom, 2002; Waldron & McLeskey, 1998; Witzel, Mercer, & Miller, 2003) and students with severe disabilities (Burns, Storey, & Certo, 1999; Kennedy, Shukla, & Fryxell, 1997; McDonnell, Mathot-Buckner, Thorson, & Fister, 2001; Mu, Siegel, & Allinder, 2000) have been successfully included in general education classrooms. On the other hand, parents, teachers, and support associations have continued to voice concerns that exceptional students' needs are not always met in inclusive settings (Mancini & Layton, 2004; McLeskey, Henry, & Axelrod, 1999; Praisner, 2003). In particular, concerns have largely focused on meeting students' needs through adaptations or modifications of the general education curriculum and instruction.

Researchers and advocates of inclusion have claimed that individualized instruction is the quintessential guide to modifying the curriculum for all students. In this model, it is typically special education teachers who are responsible for reducing curriculum capacity and teaching remedial skills, often outside the general education classroom. When Ryndak, Jackson, and Billingsley (2000) asked experts in the field of severe disabilities to define inclusion, one definition they provided was to collaboratively plan, implement, and evaluate instruction that is integrated through the general education instruction that meets the need of each student. Through a triangulation process across 19 studies, Hunt and Goetz (1997) found that curricular adaptation as a vital com-

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ponent for effective inclusion was one of the six themes that ran across the studies.

Other researchers have suggested that one reason for the potential failure of students with disabilities in general education settings is related to lesson plan development. For example, Schumm and Vaughn (1995) found that although teachers viewed accommodations as advantageous for all students, they were unable to modify their instruction due to time constraints, classroom management, and differing achievement levels of students. They also suggested that many general education teachers are uncertain of what inclusion entails and doubt their ability to teach students with disabilities. In the area of severe disabilities, Smith (2000) found that teachers did not feel they have the proper training or preparation to include students. Cawley, Foley, and Miller (2003) acknowledged that lack of teacher education and limited training within university teacher preparation programs could be a possible explanation for deficiencies in curriculum modifications.

Universal Design for Learning

One possible solution to assist special and general education teachers in developing lesson plans that accommodate a diverse student population is called Universal Design for Learning (UDL). UDL, designed by the Center for Applied Special Technology (CAST; 1998), uses flexible instructional materials and methods to accommodate a variety of learning differences (Orkwis, 2003). UDL was first derived when CAST established the National Center on Accessing the General Curriculum (NCAC; 1999). NCAC was a 5-year, federally funded program that was committed to improve general curriculum access for students with disabilities. NCAC's funding was terminated in 2004; however, its achievements are carried on today at CAST. CAST's Web site describes UDL as a "blueprint for creating flexible goals, methods, materials, and assessments that accommodate learner differences" (CAST, 1998, ¶ 2). This instructional application extends the early principles of *universal design* from architecture, where easily accessible structures (e.g., cut-away curbs, captions on televisions, automotive doors) were created to accommodate a variety of users (Burgstahler, 2001) to actively participate in everyday activities.

IDEIA (2004) recognizes the term *universal design* according to Section 3 of the Assistive Technology Act (1998). The act states that universal design "is a concept or philosophy for designing and delivering products and services that are usable by people with the widest possible range of functional capabilities, which include products and services that are directly usable (without requiring assistive technologies) and products and services that are made usable with assistive technologies" (pp. 8–9).

Similar to the guidelines of architects, UDL introduces the notion that teachers should plan instructional supports at the beginning of lesson planning, instead of modifying materials as an afterthought (Hitchcock, 2001). The UDL model introduces educators to three components for overcoming barriers that are particularly presented within the general education classroom: representation, expression, and engagement (CAST, 1998).

Representation refers to modifications that can be made to classroom materials that would make them more accessible to students with disabilities (e.g., modified books, larger print, digital text). The second component, *expression*, designates alternate methods of communication for students with limited speech (e.g., use of augmentative devices, computers, graphic programs). This second component explains how students can express themselves by answering questions and communicating within the classroom setting. The third component, *engagement*, designates the use of strategies that involve students with disabilities in the learning process (e.g., providing repetition, familiarity, opportunities to respond). To encourage engagement for all students, the curriculum needs to provide flexible alternatives.

Much of the UDL literature provides basic descriptions of UDL principles and components and suggestions on how to implement them (Hitchcock, 2001; Hitchcock, Meyer, Rose, & Jackson, 2002; Rose, 2001). Some researchers (e.g., O'Connell, 2001; Rose & Dolan, 2000) have focused on examining current limitations of traditional teaching practices and providing alternative methods for emphasizing a broader curriculum access for students with disabilities. Other researchers (e.g., Orkwis, 2003; Rose & Meyer, 2002) examined the role of pragmatic classroom settings and teachers' perceptions of instructional accommodations.

With the present emphasis on scientific research in education and special education (Odom et al., 2005; Shavelson & Towne, 2002; Spooner & Browder, 2003), it is essential to develop experimental studies that provide the educational community with evidence-based practices. Although there has been some documented success with students with disabilities in the general curriculum (e.g., Kennedy et al., 1997; McDonnell et al., 2001), there is a lack of scientific investigation on the feasibility, application, or use of UDL.

The purpose of this study is to determine the effects of teacher training about UDL on the lesson plan designs of special education and general education teachers in a college classroom setting. It was reasoned that before UDL can have a profound impact on teaching and learning, there must be evidence that teachers can learn to use it in planning instruction for students with disabilities.

Method

Participants

Participants were 72 graduate and undergraduate students enrolled in four education classes (i.e., two special education classes and two general education classes) in a southeastern university. Participants ranged in age from 19 to 58 years, with a mean age of 33 years. There were 55 (76%) women and 17 (24%) men. Sixty (83%) of the participants were European American, 9 (13%) were African American, and 3 (4%) indicated other ethnicities. Twenty-one (29%) of the participants were working toward a bachelor's degree, and 51 (71%) of the participants were working toward a master's degree. Forty-one (57%) of the participants were special education students, and 31 (43%) were general education students. Further demographics showed that 13 (18%) of the participants had never written a lesson plan, 63 (87%) were unfamiliar with UDL, and none of the participants had written a lesson plan considering the concepts of UDL. The participants who had not written a lesson plan were in the special education class, representing approximately a quarter of the class (24%). Furthermore, the special education class had more participants with UDL knowledge (17%) than the general education class (3%).

Setting

The participants gave their informed consent and volunteered to take part while enrolled in two special education classes and two general education classes at a southeastern university. The courses used were General Curriculum Access, Instructional Planning of Lesson Plans, Middle-Grade Science Methods, and Middle-Grade Math Methods. These courses were chosen based on the following criteria: (a) course objectives, (b) number of students in the classroom, and (c) pertinence of the topic to the class. The courses' objectives were considered so that there would not be a discrepancy between the intervention and the material that was required under the course title. The number of students in the classroom was considered adequate to provide power to the study. Finally, the four courses were considered appropriate if a class meeting was scheduled in their syllabus to discuss instructional accommodations. All of these courses had lectures planned that were related to this study, with one course (i.e., General Curriculum Access) having a lecture on UDL.

Procedure

Participants in each of the four classes were randomly assigned to either the treatment group or the control group. In each of the four courses, after the pretest, the participants placed their names into a hat. Names were then chosen from the hat to determine whether the participants were in the control group or in the treatment group. On the following class meeting, those chosen for the control group came to class one hour later than those in the treatment group. The intervention consisted of a 1-hour lecture on UDL conducted by one of the co-investigators of the study. The control group received the UDL lesson after completion of the posttest. One of the classroom instructors' videotaped the 1-hour UDL intervention for the control group students to watch later in the semester, whereas the other three instructors repeated the UDL lesson to the control group. The same set of instructional materials (i.e., PowerPoint slides) was used for each presentation.

The intervention was a 1-hour classroom presentation on how to modify lesson plans for students with severe and mild disabilities using the three components of UDL. The presentation consisted of an introduction to the three principles of UDL and training on how to incorporate these principles into daily lesson planning. The introduction to UDL included a description of the individual components that make up universal design according to CAST. For example, visual cues, such as re**<u>present</u>**ation, **<u>express</u>**ion, and **<u>engage</u>**ment (i.e., underlining and putting key words into bold lettering), were given to allow participants a strategy to remember using UDL concepts in developing their own lesson plans. As the UDL concept of re**<u>present</u>**ation includes developing innovative approaches in presenting materials to students, it was important for participants to remember the term *present*.

To begin implementing daily lessons involving UDL concepts, participants were provided with explicit examples of how students with disabilities may be included in the general curriculum. This was done through the use of a case study (see Figure 1) with a given set of state competencies, including math, language arts, and science goals that were to be addressed. Participants were given various examples of modifying instruction using several types of augmentative devices (e.g., individual prerecorded response pads, leveled communication boards) and modified books (e.g., novels adapted using Boardmaker™ symbols). Participants were then asked to come up with their own examples. In the culminating step, participants, along with the presenter, worked together in developing a universally designed lesson plan (using the pretest case study) that incorporated all three components of UDL. Once the intervention had taken place, participants completed a posttest. The posttest involved a newly constructed case study, including both (a) a different student with disabilities and (b) a variety of state competencies that should be addressed.

Instrumentation. Participants taking the special education coursework were given a case study of a student with a severe disability, whereas the participants in the general education math courses were given a case study that focused on a student with a mild cognitive disability (e.g., a learning disability or dyslexia). The case study consisted of a general description of the student's strengths and interests and three general education curriculum goals, one each in the subject areas of language arts, math, and science (see Figure 1 for an example). The participants were asked to create a lesson plan focusing on the components of universal design for one general curriculum goal as a means to include a student with a disability into the general education classroom. A comparable novel case study was created for the posttest.

A basic lesson plan format was created to include objective, materials, procedure, guided practice, independent practice, and assessment for the lesson as well as an extra section to provide examples and a clear description of how they would use the three components of UDL to make the curriculum accessible for the student with a disability. Participants' lesson plans were scored after the pretest and posttest using a scoring rubric specifically designed for the study (see Table 1). The scoring rubric consisted of a 3-point scale and evaluated the participants' lesson plans using the three components of UDL. There was a maximum number of 6 points available on the rubric. Points were distributed based on three given criteria:

- 0 points if there was not a clear description of each component,
- 1 point if one or two modifications were discussed, and
- 2 points if three or more modifications were discussed.

Content validity was measured by an expert panel composed of a special education professor with expertise in curriculum adaptation, a math education professor who was experienced in the inclusion of students with disabilities into general education classrooms, and a research associate with expertise in research on the literacy of students with significant disabilities. This panel met on three separate occasions throughout the research experiment. Materials such as the UDL instructional package, lesson plans, and case studies made by the investigators were reviewed by the panel to determine the degree to which the materials were representative of the content area. The panel also reviewed pre- and posttest case studies and found them to be comparable.

Procedural fidelity was measured during the 1-hour instruction sessions, using an observer checklist (see Figure 2) to ensure that each topic of the presentation was addressed and discussed. The presentation format used the checklist, in which the professor or teaching assistant marked the procedural fidelity checklist against what was actually being taught. The checklist included the three essential components of UDL and the steps involved in modifying a lesson plan. Using this checklist, uniform lessons across the four classes could be determined. Procedural fidelity checklists showed a 100% accuracy of delivery. As a check of interrater reliability on the scoring of the pretest and posttest lesson plans, 33% of the plans were randomly selected from Microsoft Excel and scored by the second and third authors. The authors used the scoring rubric, then compared the number of agreements and divided them by the number of total possible points. The percentage of interrater reliability agreement was 90%.

Design and Data Analysis Procedures

This study was a true pretest–posttest experimental group design with a randomly assigned control group. This design was

Mr. Allmon is a teacher in a third-grade classroom at a public school. His class consists of 24 students, including 1 student with severe mental disabilities (Rhonda, see below). This class is currently working on a language arts unit about animal and plant life. Students have previously read several books about different animals and have investigated life cycles using the National Geographic Web site.

Rhonda is 9 years old and currently in Mr. Allmon's third-grade general education classroom. As a very young child, Rhonda suffered from recurring ear infections and now has hearing loss in her right ear. Rhonda is also currently attending occupational therapy for weaknesses on the left side of her body. Rhonda has been labeled with a severe mental disability. Although she is nonverbal, Rhonda uses BigMacs and other forms of augmentative and alternative communication. It appears that she loves her teacher and friends, but she often complains about having to sit still all day at school. Rhonda's teachers say that she is very cooperative and motivated. Rhonda enjoys singing and painting.

Math Competency Goal 4. The learner will understand and use data and simple probability concepts.
4.01. Collect, organize, analyze, and display data (including circle graphs and tables) to solve problems.

Language Arts Competency Goal 2. The learner will apply strategies and skills to comprehend text that is read, heard, and viewed.
2.04. Identify and interpret elements of fiction and nonfiction and support by referencing the text to determine the author's purpose, plot, conflict, sequence, resolution, main idea and supporting details, cause and effect, and point of view.

Science Competency Goal 1. The learner will build an understanding of plant growth and adaptations.
1.02. Observe and describe how environmental conditions determine how well plants survive and grow in a particular environment.

State competencies found at
http://www.dpi.state.nc.us/curriculum

FIGURE 1. Sample case study used as a posttest measure.

TABLE 1. Scoring Rubric on the Three Components of Universal Design for Learning

Objective	Score: 0 points	1 point	2 points
Representation	No clear description of modifying materials to provide equal access to all students	Discusses one or two modifications of materials to provide equal access, but needs to be explained more in depth	Discusses three or more modifications of materials to provide equal access to all students; gives clear and precise explanations
Expression	No clear description of providing alternative communication methods	Discusses at least one alternative communication method, but needs to be explained more in depth	Discusses two or more alternative communication methods; gives clear and precise explanations
Engagement	No clear description of strategies to involve or engage students with disabilities	Discusses one or two strategies to involve students with disabilities, but needs to be explained more in depth	Discusses three or more strategies to involve students with disabilities; gives clear and precise explanations

chosen for its ability to control for internal validity issues (e.g., maturation, testing, selection, and regression; Campbell & Stanley, 1963). The scoring rubric mirrored the three essential qualities of UDL. Descriptive statistics were used to describe mean differences between the experimental and control groups. A three-factor analysis of variance (ANOVA) with repeated measures, comparing class, treatment group, and pretest–posttest scores, was completed for each of the dependent variables (i.e., total test score, representation, expression, and engagement scores) on the lesson plan pretest and posttest scores for the control and experimental groups.

Results

A quantitative analysis of performance was used to examine participants' abilities to develop universally designed lessons prior to and following the intervention. These results helped researchers to determine individual growth patterns for participants in both experimental and control groups.

Modified Lesson Plan

A three-factor ANOVA with repeated measures, comparing class, treatment group, and pretest–posttest scores, was completed for each of the four dependent variables. Within-group factors included the total pretest and posttest score and the pretest and posttest score for each component of UDL. The between-groups factors analyzed were class (i.e., general education vs. special education teachers) and participant group (i.e., experimental vs. control). Means and standard deviations for pretest and posttest scores for the experimental and control groups are reported in Table 2. ANOVA source tables are also provided for all dependent variables (see Tables 3 and 4).

We found statistically significant within-subject main effects for the total pretest and posttest, $F(1, 68) = 52.027$, $p < .001$, $\eta^2 = .433$; representation component, $F(1, 68) = 31.416$, $p < .001$, $\eta^2 = .316$; expression component, $F(1, 68) = 46.069$, $p < .001$, $\eta^2 = .404$; and engagement component, $F(1, 68) = 6.830$, $p = .011$, $\eta^2 = .091$. Both the special education and general education teachers in the experimental group showed an increase in mean scores from pretest to posttest (see Table 2). The scores of the special education teachers in the experimental group increased considerably from the pretest to the posttest, similar to the rise from pretest to posttest scores for the general education teachers in the experimental group. The mean scores of the special education and general education teachers in the control groups remained the same for both groups between the pretest and the posttest. Figure 3 presents a diagram indicating these differences.

Further results of this analysis also showed a statistically significant between-subjects effect for class (i.e., general education vs. special education teachers) on the total pretest and posttest, $F(1, 68) = 8.902$, $p = .004$, $\eta^2 = .116$; and expression component, $F(1, 68) = 7.066$, $p = .01$, $\eta^2 = .094$. A statistically significant between-subjects effect was also found for participant group (i.e., experimental vs. control) on the total pretest and posttest, $F(1, 68) = 45.028$, $p < .001$, $\eta^2 = .398$; representation component, $F(1, 68) = 17.791$, $p < .001$, $\eta^2 = .207$; expression component, $F(1, 68) = 14.668$, $p < .001$, $\eta^2 = .177$; and engagement component, $F(1, 68) = 33.885$,

_____ Introduction to UDL "At a Glance" concepts

_____ Instructor input: Teaching of curriculum access for all students

_____ Participant practice in developing lesson plans

_____ Questions and answers

_____ Posttests

FIGURE 2. Procedural fidelity checklist, Universal Design for Learning (UDL) agenda for instructional intervention.

TABLE 2. Class and Group Mean Scores and Standard Deviations on the Pretest and Posttest Universal Design for Learning Rubric

Group	Pretest *M*	Pretest *SD*	Posttest *M*	Posttest *SD*
General education				
Treatment	1.17	0.92	3.61	1.42
Control	1.23	1.30	1.23	1.30
Special education				
Treatment	0.83	0.98	3.13	1.22
Control	0.44	0.70	0.44	0.62

$p < .001$; $\eta^2 = .333$. Total means and standard deviations of rubric scores for the two classes (i.e., general education vs. special education) on each UDL component are reported in Table 5.

Discussion

We found that a 1-hour intervention on UDL enabled general education and special education teachers to develop lesson plans that involved a student with a mild or severe cognitive disability. These results suggest that teachers need to be informed about UDL to develop lesson plans for all learners in all environments. A three-factor analysis of variance with repeated measures for each of the dependent variables (i.e., total test score, representation, expression, and engagement scores) on the lesson plan pretest and posttest scores for the control and experimental groups found that the teachers in the experimental group improved in their lesson plan development after the 1-hour intervention. Also, judging by our scoring rubric, teachers in the experimental group showed a considerable amount of growth between the pretest (M = 0.98) and posttest (M = 3.34), compared to the control group's pretest (M = 0.77) and posttest (M = .077) scores.

One of the underlying premises of the UDL model is that teachers should plan instructional supports during the be-

TABLE 3. ANOVA Source Table for Test Rubric Scores by Universal Design for Learning Component

Source	*M*	*F*(1, 68)
Representation		
Between groups		
Class	0.89	2.95
Group	5.39	17.79*
Class × Group	1.22	1.29
Error	0.30	
Within group		
Test	6.36	25.29*
Class × Test	0.39	0.16
Group × Test	7.90	31.42*
Class × Group × Test	0.18	0.69
Error	0.25	
Expression		
Between groups		
Class	2.80	7.07*
Group	5.81	14.67*
Class × Group	0.01	0.01
Error	0.40	
Within group		
Test	6.12	35.95*
Class × Test	0.40	2.32
Group × Test	7.84	46.07*
Class × Group × Test	0.91	0.54
Error	0.17	
Engagement		
Between groups		
Class	0.87	3.30
Group	8.92	33.89*
Class × Group	0.20	0.77
Error	0.26	
Within group		
Test	4.74	23.54*
Class × Test	0.37	0.19
Group × Test	1.38	6.83
Class × Group × Test	0.30	1.47
Error	0.20	

*$p < .01$.

TABLE 4. ANOVA Source Table for Test Rubric Scores by Universal Design for Learning Component

Source	*M*	*F*(1, 68)
Between groups		
Class	12.38	8.90*
Group	62.60	45.03*
Class × Group	1.22	0.87
Error	1.39	
Within group		
Test	48.70	52.03*
Class × Test	0.42	0.05
Group × Test	48.70	52.03*
Class × Group × Test	0.42	0.05
Error	0.94	

*$p < .01$.

TABLE 5. Means and Standard Deviations of Rubric Scores by Universal Design for Learning Component on Pretest and Posttest

	Pretest		Posttest	
Group	*M*	*SD*	*M*	*SD*
Representation				
Treatment	0.27	0.45	1.17	0.63
Control	0.32	0.54	0.29	0.46
Engagement				
Treatment	0.43	0.50	1.02	0.57
Control	0.13	0.34	0.29	0.46
Expression				
Treatment	0.26	0.50	1.14	0.57
Control	0.32	0.54	0.25	0.58

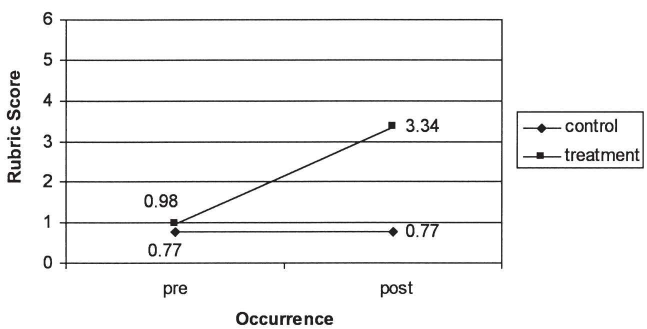

FIGURE 3. Comparison of treatment and control group mean Universal Design for Learning scores on the pretest and posttest. A 6-point scoring rubric was used to grade the lessons.

ginning of lesson planning, instead of modifying materials as an afterthought (Hitchcock, 2001). A possible implication of this study is that universally designed concepts might save teachers an extensive amount of time by creating modified lesson plans rather than changing them after the fact. By designing lessons before the fact, considering all students using the components of UDL, teachers have a better opportunity to teach a curriculum that actively involves all students. Participants in this study were given approximately 20 min to complete lesson plans during the posttest, and they were able to create a lesson plan with modified instruction for all students, including those with disabilities, within that 20-min time period.

We found that training on the concepts and application of UDL can provide general education and special education teachers with the lesson planning skills needed to design a universal curriculum for all students. This study used the three components of UDL (i.e., representation, expression, and engagement) developed by CAST to help teachers make the curriculum more accessible for students with disabilities. Although there has been evidence of students with severe disabilities having access to the general education curriculum (e.g., Kennedy et al., 1997; McDonnell et al., 2001), there has been a paucity of data-based studies focusing on UDL. Our outcomes support the work of CAST by providing teachers with a way to use the components of UDL to create access to the general education curriculum for all students.

Furthermore, we found that when general education teachers are taught the three components of UDL, they can write modified lesson plans involving representation, expression, and engagement. Although previous investigators (e.g., Cawley et al., 2003; Schumm & Vaughn, 1995) found that many general education teachers believed they were unable to modify instruction due to lack of training, time constraints, classroom management, and student levels, our results show that these teachers were capable of successfully modifying lesson plans with only a 1-hour lecture on the concepts of the three components of UDL and how to apply these three components to modify instruction to create access (intervention).

Many earlier contributions to the literature on the concepts of UDL have focused on basic descriptions and principles of UDL, whereas others have presented audiences with suggestions on how to implement them (Hitchcock, 2001; Hitchcock et al., 2002; Rose, 2001). Several authors have focused on examining the current limitations of traditional teaching practices and providing alternative methods for emphasizing a broader curriculum access for students with disabilities (O'Connell, 2001; Rose & Dolan, 2000). Based on our findings, we suggest that future data-based research, using experimental designs, can be implemented with UDL. Future investigators should focus on the impact of UDL planning and instructional methods that tailor materials and assessments to meet the demands of all students.

Limitations

Some limitations should be mentioned about this research study. First, there were only four college courses selected for this study, with a total of 72 participants; however, the participants in each class were randomly assigned to the control or experimental groups. Future studies may look at a larger population of teachers so that the results can be generalized. Second, some of the teachers in this study were lateral-entry teachers (i.e., teachers who do not hold a teaching license but have a 4-year college degree) at local public schools, and some were graduate students with little teaching experience. Additional research could focus on lateral-entry teachers to examine the effects of UDL training and knowledge on their lesson plan development to include students with disabilities or physical limitations into their classrooms. Furthermore, supplementary studies may examine special education and general education teachers who hold valid teaching licenses and look at the effects of UDL training on their previous ways to write a lesson plan. These studies may also examine the longitudinal effects of UDL lesson plans in order to investigate if teachers are continuing to use these concepts in the classroom. Fourth, the teachers were only allowed 20 min to write their lesson plans. Many teachers indicated that more time was needed to make the lesson plan more descriptive. Prospective studies should examine the effects of allowing more time on UDL lesson plan development. Finally, it should be noted that a few of the mean scores and standard deviation scores appeared the same from pretest to posttest. This may be due to the low scoring scale on the scoring rubric or to the absence of knowledge about UDL among the participants (e.g., 18% had never written a lesson plan, 87% were unfamiliar with UDL, and none of the participants had written a lesson plan considering the concepts of UDL). All in all, the results of this study should be taken with caution due to the possibly unique success of the intervention with this particular situation or instructors.

In conclusion, this study adds to the database of experimental studies investigating the impact that UDL has on improving access to the general education curriculum. Based on the current teacher shortages in special education across the nation, many people are hired and hold a teaching position but have very little if any experience. More research is needed on the principles and application of UDL and teacher training. This study serves as a building block for additional research on UDL. Future investigations using the concepts of UDL during teacher training to provide more opportunities for students with various disabilities to be included and have access to the general education curriculum appear warranted.

Practical Implications

During our intervention, we did not focus only on the technology side of UDL but, rather, focused on the definition of universal design as used in IDEIA. For example, a teacher may have a student who has a learning disability in math. The teacher may use representation by presenting the material using concrete manipulatives (e.g., base-10 blocks, algebra tiles, geoboards, or multisensory touch points). This use of concrete manipulatives will also assist in engaging students by allowing them to use different modalities than the traditional written problems. Next, the teacher will use expression by considering the multiple ways in which the child can express him- or herself (e.g., if a student is unable to compute 2-digit by 2-digit multiplication problems with decimals, then the teacher may want to simply give the student the answer and then have him or her place the decimals correctly within the answer).

Although it appears that UDL principles depend on the knowledge and use of technology, this is certainly not the case. This study shows that even without the use of expensive technology, talented teachers can create lesson plans that involve students on all levels (i.e., mild, moderate, or severe cognitive disabilities). Rather than continuously using traditional instructional methods, it is important that both general and special educators begin to use methods of teaching that mimic real-life problem situations (e.g., calculating mileage for a trip, solving a mystery in a book, ordering from a restaurant menu, and calculating tips or taxes). Examples of how to include students with disabilities may involve having students work in cooperative groups, having students listen to tape-recorded information, allowing students to draw or paint sequenced steps from a book, having students make up a song summarizing information learned, or actively involving students in a science experiment. The use of creativity in problem solving can help students to see overall representations of objectives without feeling overwhelmed by a multitude of written instructions. ■

FRED SPOONER, PhD, is a professor of special education and serves as a senior research associate in an Institute for Education Sciences–funded center with a focus on teaching students with moderate and severe disabilities to read at University of North Carolina–Charlotte (UNCC). His current interests include instructional procedures for persons with significant disabilities, alternate assessment, and linking assessment and instruction to the general curriculum. **JOSHUA N. BAKER**, MA, is a doctoral student in the special education program at UNCC. His current interests include accessing the general curriculum, alternate assessment, and Universal Design for Learning for students with significant disabilities. **AMBER A. HARRIS**, MEd, is a doctoral student in the special education program at UNCC. Her current interests include Universal Design for Learning and teaching academic skills to students with mild disabilities. **LYNN AHLGRIM-DELZELL**, PhD, is a research associate on projects related to alternate assessment and literacy for students with severe disabilities. Her current interests include alternate assessment, teaching and assessing literacy skills to students with significant cognitive disabilities, and mental illness in individuals with cognitive disabilities. **DIANE M. BROWDER**, PhD, is the Snyder Distinguished Professor of Special Education and serves as principal investigator in an Institute for Education Sciences–funded center with a focus on teaching students with moderate and severe disabilities to read at UNCC. She is a partner in the National Center on Alternate Assessment and principal investigator for Office of Special Education Programs–funded projects on access to the general curriculum. Her current interests include alternate assessment and linking assessment and instruction to the general curriculum. Address: Fred Spooner, PhD, Department of Special Education and Child Development, College of Education, UNC Charlotte, 9201 University City Boulevard, Charlotte, NC, 28223-0001; e-mail: fhspoone@email.uncc.edu

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Universal Design for Learning in Postsecondary Education: Reflections on Principles and their Application

David H. Rose

Center for Applied Special Technology (CAST), and Harvard University

Wendy S. Harbour
Catherine Sam Johnston
Samantha G. Daley
Linda Abarbanell

Harvard University

Abstract

Authored by the teaching staff of T-560: Meeting the Challenge of Individual Differences *at the Harvard Graduate School of Education, this article reflects on potential applications of universal design for learning (UDL) in university courses, illustrating major points with examples from T-560. The article explains the roots of UDL in cognitive neuroscience, and the three principles of UDL: multiple means of representing information, multiple means of expressing knowledge, and multiple means of engagement in learning. The authors also examine the ways UDL has influenced their course goals and objectives, media and materials, teaching methods, and assessment techniques, including discussion groups, lectures, textbooks, and the course website. The authors emphasize the ongoing developmental nature of the course and UDL principles as tools or guidelines for postsecondary faculty, rather than a set of definitive rules. UDL is proposed as a way to address diversity and disabilities as constructs of individuals and their environment in higher education classrooms.*

Universal design, although well established in architecture and other domains, is relatively new to K-12 education and even newer to higher education. Universal design involves designing products, buildings, or environments so they can be used readily by the widest possible range of users. Although, this concept of universal design is now familiar to many educators, its application in education lags far behind its application in the built environment. We believe this lag reflects an important reality: The *idea* of universal design transfers readily from the built environment to the learning environment, but its *principles* and *techniques* do not.

In this paper, we will clarify the differences between applying universal design in these two contexts, illustrating the principles of what we call universal design for learning. To illustrate some of these principles in action in higher education, we will describe the university course for which the authors are the faculty and teaching assistants. First, however, we will make some distinctions between terms that are sometimes confused: assistive technology, universal design, and universal design for learning.

Assistive technologies are technologies that are specifically designed to assist individuals with disabilities in overcoming barriers in their environment. Some relatively "low-tech" assistive technologies (e.g., canes, wheelchairs, eyeglasses) have been in place for over a century, but the addition of "high-tech" assistive technologies over the last three decades has often provided the most dramatic impact on higher education experiences for students with disabilities, while capturing the attention of the public. Examples of these newer technologies include such devices as electronic mobility switches and alternative keyboards for individuals with physical disabilities; computer screen enlargers and text-to-speech readers for individuals with visual disabilities; electronic sign language dictionaries and cochlear implants for individuals who are hard of hearing or deaf; and calculators, digital talking books, and spell-check devices for individuals with learning disabilities. Because they are designed for individual use, assistive technologies can be carefully engineered, fitted, and adapted to the specific strengths and functional limitations of an individual student. In that regard they are unique, personal (they travel with the individual), customized, and dedicated. While some of these assistive technologies are also popular with nondisabled members of the general public, they are typically designed to increase access and learning among people with disabilities and to remedy barriers or limitations in the built environment (e.g., the classroom, computers, printed books). Further the term *assistive technology* is rarely used to describe technology or equipment for nondisabled consumers.

Universal design focuses on eliminating barriers through initial designs that consider the needs of diverse people, rather than overcoming barriers later through individual adaptation. Because the intended users are whole communities, universally designed environments are engineered for flexibility and designed to anticipate the need for alternatives, options, and adaptations to meet the challenge of diversity. In that regard, designs are often malleable and variable rather than dedicated. They are not unique or personal, but universal and inclusive. Universal design is an ideal that is not yet met completely in practice.

Universal design for learning (UDL) is one part of the overall movement toward universal design. The term emphasizes the special purpose of learning environments—they are not created only to transmit information or to shelter, but are created to support and foster the changes in knowledge and skills that we call learning. While providing access to information or to materials is often essential to learning, it is not sufficient. UDL requires that we not only design accessible information, but also an accessible pedagogy. In general terms, pedagogy is the science of teaching and learning—the educational methods that skilled educators use to highlight critical features, emphasize big ideas, clarify essential relationships, provide graduated scaffolds for practice, model expert performance, and guide and mentor the apprentice (or student). All of these and more are what teaching is, and the measure of their success is what we call learning. The framework for UDL is based in findings from cognitive neuroscience that tell us about the needs of individual learners. It embeds accessible pedagogy into three specific and central considerations in teaching: the means of representing information, the means for students' expression of knowledge, and the means of engagement in learning (for further details, see Rose and Meyer, 2002, and Rose, Meyer, and Hitchcock, 2005).

UDL Principles

The distinction between UDL and other domains of universal design is its focus on learning. The principles that are central to UDL reflect that focus, because they address access to the dynamic processes of teaching and learning, not access to the fixed structures of buildings, or even to information. As a result, the principles are different from the well-known principles for making the physical environment universally designed, as developed by Ron Mace (Bowe, 2000). While the idea of universal design shares the same ideological foundation in both learning environments and built environments, the principles and techniques for achieving universal design reflect the differences between them.

It should be noted that the principles of UDL are not guidelines. For the last three years, as part of a cooperative agreement with the U.S. Department of Education, the Center for Applied Special Technology (CAST) has been developing guidelines for UDL based on three overarching principles. Because CAST is a non-profit research and development organization dedicated to widespread implementation of universal design in education, the three principles and the UDL guidelines they support are derived not from architecture or product design, but from learning. The guidelines will soon be released publicly and may be found at http://www.cast.org.[1] The principles of UDL that underlie these guidelines are discussed below.

Principle One: Multiple Means of Representation

Students differ in the ways that they perceive and comprehend information presented to them. At the extreme are students with disabilities (e.g., those who are blind or deaf), for whom some forms of presentation are completely inaccessible. More prevalent are students who, because of their particular profile of perceptual or cognitive strengths and deficits, find information in some formats much more accessible than others (e.g., students with dyslexia, aphasia, mental retardation). Even more common are students with atypical backgrounds in the dominant language, cognitive strategies, culture, or history of the average classroom who, therefore, face barriers in accessing information when presented in a manner that assumes a common background among all students. There is no common optimal means of representing information to address these diverse learners' needs.

But making information accessible is not enough. The goal of education is not only to make information more accessible; that is a goal for librarians, publishers, or engineers of popular search engines. The goal of education is to teach students how to work with information, including finding, creating, using, and organizing information. There is an important distinction between accessing information and using it. As a result, the first principle of UDL applies also to the methods and techniques for *teaching*, ensuring that the means for highlighting critical features, emphasizing big ideas, connecting new information to background knowledge, modeling inquiry, and so forth, are fully accessible to all students.

The first principle reflects the fact that there is no one way of presenting information or transferring knowledge that is optimal for all students. Multiple means of representation are key.

Principle Two: Multiple Means of Expression

Students differ in the ways they can navigate a learning environment and express what they know. Students do not share the same capacities for action within or across domains of knowledge. Some students have specific motor disabilities (e.g., cerebral palsy) that limit the kinds of physical actions they can take, as well as the kinds of tools that they can use to respond to or construct knowledge. Other students have adequate motor control but lack the ability to integrate action into skills (e.g., students with dysgraphia or the spelling challenges associated with dyslexia). Still others are skillful within a domain but lack the strategic and organizational abilities required to achieve long-term goals (e.g., students with executive function disorders or attention deficit disorder/attention deficit hyperactivity disorder [ADD/ADHD]). Moreover, many students are able to express themselves much more skillfully in one medium than in another (using drawing tools or video editing as opposed to writing and reading print, for example).

Making sure there are alternatives for students' means of expression is only one aspect of UDL as applied to expression. It is also essential to ensure that there are accessible alternatives in the various scaffolds and supports provided for student learning. That means providing alternatives in mentoring, modeling various scaffolding that can gradually be released as students gain competency, and feedback that is essential to learning and growth. For example, scaffolds and supports at the postsecondary level can include review sessions, opportunities for students to receive feedback on project topics before they are submitted, and optional readings to address learners with different levels of prior knowledge (i.e., readings providing either background information or advanced discussion of course topics).

Thus, the second principle reflects the fact that there is no one means of expression that will be optimal for all students, nor one kind of scaffolding or support that will help them as they learn to express themselves. Multiple means are essential.

Principle Three: Multiple Means of Engagement

Students also differ markedly in the ways in which they are engaged or motivated to learn. Some students are highly engaged by spontaneity and novelty (e.g., students with ADD/ADHD), but others are disengaged or even frightened by those aspects in a learning environment (e.g., students with Asperger's Syndrome or autism). Similarly, some students are engaged by risk and challenge in a learning environment, while others seek safety and support. Some are attracted to dynamic social forms of learning, and others shy away and recede from social forms. There is no one means of engaging students that will be optimal across the diversity that exists.

Lastly, it is not enough to merely engage students by external means. Students must develop the internal standards and motivation that will prepare them for successful work and future learning. The ways in which faculty teach the discipline and curiosity that their fields require, the often subtle rewards of accomplishment and choice, and many other aspects of disciplinary self-regulation—these too need to be modeled and supported in ways that are attainable by students with very different emotional and attitudinal histories.

The third principle reflects the fact that not all students are engaged by the same extrinsic rewards or conditions, nor do they develop intrinsic motivation along the same path. Therefore, alternative means of engagement are critical.

The Basis for the Principles

Why these three principles? The three principles reflect the basic neurology of the learning brain as described by many (see, e.g., Cytowic, 1996, and Luria, 1973). Broadly speaking, the principles reflect three general components: one that learns to recognize objects or patterns in the external environment, one that learns to generate effective patterns of action or response, and one that learns to evaluate the significance or importance of the possible patterns we encounter or generate. Each of these components is involved not only in learning generally, but in the functions that we call memory, language processing, problem solving, and thinking. A brief expansion of the three networks follows.

Recognition networks. Most of the posterior (back) half of the brain's cortex is devoted to recognizing patterns (see, e.g., Farah, 2000, and Mountcastle, 1998).

Pattern recognition makes it possible to identify objects and events in the world on the basis of the visual, auditory, tactile, and olfactory stimuli that reach our receptors. For example, through these networks we learn the distinctive patterns that constitute a book, a dog's bark, the smell of burning leaves, and so on. When we read, to take a more cognitive example, we recognize the patterns in letters, words, sentences, and even in an author's style. When recognition systems in the posterior cortex are damaged or undeveloped, the brain's capacity to know what things are - to recognize the meaning of objects, symbols, or signs - is compromised. From a neurological perspective there are many names for recognition problems, including the receptive aphasias (difficulty recognizing spoken words), the visual agnosias (difficulty recognizing objects that are seen), dyslexias (difficulty recognizing written words), amusia (difficulty recognizing the patterns in music), and so forth. Imaging studies on many types of recognition problems, including recent work on dyslexia, have revealed atypical patterns of posterior activation (Shaywitz, 2005).

Strategic networks. The strategic networks are areas of the brain that underlie our ability to plan, execute, and monitor skills and actions. They include those areas often referred to as "executive functioning." The anterior part of the brain (the frontal lobes) primarily comprises the networks responsible for knowing *how* to do things, such as holding a pencil, riding a bicycle, speaking, reading a book, planning a trip, or writing a narrative. Actions, skills, and plans are highly patterned activities, requiring the frontal brain systems to generate such patterns. Working in concert with posterior recognition systems, frontal systems allow us to learn to read actively, to write, to solve problems, as well as to plan, execute, and complete compositions and projects (Fuster, 2002; Goldberg, 2002; Jeanerrod, 1997; Stuss & Knight, 2002). Damage or weakness in these frontal regions leads to problems that are called apraxias or dyspraxias in the neurological literature (i.e., problems in action or in planning for action). But these frontal systems are also critical for learning *how to act* on information. In reading, for example, one has to know *how* to look for patterns: how to look at the critical features of letters, how to "sound out" an unfamiliar word, how to look for the antecedent of a pronoun, and how to look for an author's point of view. Not surprisingly, the frontal cortex lights up in skilled readers when they are reading texts (Sandak & Poldrack, 2004; Shaywitz & Shaywitz, 2004).

Affective networks. At the core of the brain (the extended limbic system) lie networks responsible for emotion and affect. Neither recognizing nor generating patterns per se, these networks determine whether the patterns we perceive matter to us and whether they are important, and then they help us decide which actions and strategies to pursue. They are not so critical in knowing how to recognize an apple, but in knowing whether an apple is important to us at the moment (see, e.g., Damasio, 1994; Lane & Nadel, 2000; LeDoux, 2003; Ochsner, Bunge, Gross, & Gabrieli, 2002; Panksepp, 1998). The affective networks, like strategic and recognition networks, are distinctive parts of a distributed system for learning and knowing (Lane & Nadel, 2002; LeDoux, 2003).

Under normal circumstance, like viewing a picture, affective networks underlie the fact that different aspects of the picture will strike different individuals as significant or meaningful. Those features will attract more attention, and be remembered better than others. For example, men and women differ in the details of what they attend to and remember in complex pictures (Barbarotto, Laiacona, Macchi, & Capitani, 2002). Every individual has a unique history, which affects somewhat what is important about a picture. Damage to the affective networks can impair the ability to establish priorities, select what we value or want, focus attention, or prioritize actions. These affective factors are a critical part of any act of learning (see Damasio, 1994, for example).

All three networks work together in learning, each contributing an essential part. What is important about this basic framework is that it continually reminds us of what must be done to ensure that learning is accessible to students. It is not enough merely to make classrooms or textbooks accessible. Successful learning environments require attention to three things: providing information and informational supports that are accessible to all students, providing ways of acting on information that are accessible to all students, and providing ways of engaging and motivating learning that are accessible to all students. The UDL principles reflect those three aspects in the design of learning environments.

Applications of UDL in a University Course

In this section we will illustrate attempts to apply the principles of UDL in an ongoing university course. Despite recent attention to universal design in higher education research and the Association on Higher Education And Disability (AHEAD, a professional organization for disability services providers), there has been a general lack of interdisciplinary attention on the part of postsecondary faculty. In particular, research and application still lags behind theory, and prevalent models are generally rooted in architectural principles of universal design rather than pedagogical and neuropsychological research (see, e.g., McGuire, Scott, & Shaw, 2004). Discussion of UDL application in higher education courses is rare, especially at the graduate level. With these issues in mind, we will address four areas: the goals and objectives of the course, the media and materials that are used in the course, the course discussion groups, and the ways in which student progress is assessed.

We will describe our semester-long course called *T-560: Meeting the Challenge of Individual Differences*, offered at the Harvard Graduate School of Education. In the 2004-2005 academic year, 93 graduate students were registered (mostly master's students but also some doctoral students), an enrollment that is quite large for Harvard's school of education. The students who take the course are diverse in background and interests, and a significant number have cross-registered from other colleges (e.g., law, public health) or other universities (e.g., the Massachusetts Institute of Technology). In general, however, the majority of students come from three areas within the graduate school of education: human development (especially those interested in mind, brain, and education); technology in education; and teaching and curriculum development. Many students interested in disabilities and special education also take the course, although there are no particular degree programs or concentrations in those subjects at Harvard University.

From the outset, we acknowledge that T-560 is not a perfect demonstration of UDL. Many aspects of the course would fail to meet any standard for UDL. Like UDL itself, the course is a work in progress, not a destination. We offer our observations merely as travelers on a journey, and we look forward to your suggestions as fellow travelers. Furthermore, we encourage readers not to take our observations as rules or steps to follow. UDL emerges differently in different contexts. The ideas here are merely a set of starter tools, not a complete vision, and we expect to learn a great deal as we travel ahead and incorporate additional advice, research, and experiences.

Goals of T-560

Like many postsecondary courses, T-560 began with goals that were largely ambiguous. Set in the context of a university, the implicit goal was to teach information and ideas, specifically about applying neuroscience to education. Its methods were completely traditional, including lectures and readings that were selected to transfer facts and ideas from the instructor and authors to eager (and sometimes not so eager) students.

Over time that course content migrated somewhat, as did its instructional methods, and finally its goals. The current course description reads as follows:

In the era of No Child Left Behind and IDEA, the challenge of individual differences faces every teacher, administrator, and curriculum designer. The media and materials of the general education curriculum, once designed primarily for a narrow and illusive group of "regular" students, must now ensure results for students with a much wider range of abilities and disabilities. This course will explore recent advances that are critical to meeting this challenge. The first half of the course will address recent research in the neuroscience of learning—providing a new framework for understanding the range of individual differences that must be addressed. The second half will address recent advances in the design of educational media and technologies—advances that meet the challenge of individual differences through universal design.

With this basic information about the outline of the course, it is instructive to consider its goals from a UDL perspective, including consideration of three aspects of the goals, following the three primary principles of UDL.

First, there is the obvious goal: teaching information. The course is clearly intended to teach information on a variety of topics: neuroscience, learning in the brain, individual differences in the way our brains learn, the limits and strengths of various educational media for teaching, as well as the ways in which they can be individualized. This goal has remained fairly consistent over the last decade. The first principle of UDL reminds us that information must be presented in multiple ways in order for that goal to be achieved for a wide range of students.

But the UDL framework requires a broader understanding of goals and objectives. The framework reminds us that it is not enough for students to acquire information; they must also have some way to express what they have learned, and some way to apply that information as knowledge. Only in its expression is knowledge made useful. Thus, the goals for the course must also have an expressive component. It is not only important that students have information, but that they know how to apply the information in appropriate settings, including the kinds of work they will likely perform during their lives ahead. Thus, the second principle reminds us that there must be multiple means for expressing their knowledge, and multiple means for learning the skills that will underlie that expression.

The third UDL principle reminds us also that there is also an affective component to reaching any goal. While the explicit goals of a course tend to focus on the first two principles - the knowledge students will learn and the skills to express that knowledge - the third is just as critical. Students will never use knowledge they don't care about, nor will they practice or apply skills they don't find valuable. So, another goal of the course is affective. We want students to be fully engaged in learning the content, to be eager to apply what they know, to leave the course wanting to learn even more, and to want to apply their knowledge everywhere. Unfortunately, we currently do not evaluate this third goal systematically enough. As members of the teaching staff for T-560, we do conduct regular weekly "check-in" discussions with each other before and after classes to talk about our individual observations, engagements, or motivations with that week's material, as well as any feedback or concerns from students. We informally assess student engagement through observation during classes and discussions, as well as through formal written course evaluations mandated by the Harvard Graduate School of Education. Yet, ongoing evaluation of engagement and motivation remains a challenge.

Applying UDL Principles to Course Lectures

Typical courses in universities are dominated by two types of media: lectures and textbooks. It is legitimate to ask whether such a prominent position is warranted: are lectures and textbooks effective media for instruction? Not surprisingly the answer is: it depends. While lectures and textbooks play an important role in instruction everywhere, both of them are ineffective for some students in all content areas, and for all students in some content areas.

While that caution is worth stating at the outset, we are not going to try to slay that dragon here. At this time, and for the immediate future, it is a given that universities will use lectures and textbooks as the predominant means of mass instruction. And so lectures and books are very central to T-560, too. For that reason, we will begin our discussion of the course materials with them, highlighting how they are modified and used within the context of UDL. But it is important to clarify that lectures and books are presented within a somewhat different overall context in our course. The lectures and readings, and other media and activities as well, are embedded within a course website that forms the primary "container" or "backbone" of the course. Elements of this site will be described throughout this section, and the site itself is discussed in more detail later.

First, it is important to reflect on the strengths of lectures. Why are they important in postsecondary education? What is important to capture or save in any form of alternative representation? The strengths of a lecture are derived from the enormous expressivity of the human voice. It is not the content or language itself - neither the semantics nor syntax - that is uniquely powerful; in fact, those aspects of a lecture are often conveyed more accessibly in a printed version of the lecture. What sets lectures apart is the enormous expressive capacity of spoken language, including its ability to stress what is significant and important, to clarify tone and intent, to situate and contextualize meaning, and to provide an emotional background. The feeble use of graphic equivalents to indicate significance (e.g., exclamation points and italics) cannot match the ability of spoken language to convey affect, such as irony or scorn, or to emphasize for clarity. This is why in reading a printed speech, the power of language usually evaporates for any audience (unless the speaker is a gifted reader or actor). Speech coaches usually discourage public speakers from reading speeches because the natural expressivity of spoken speech is difficult to mimic when text has been provided in written form. It is not only the sounds of speech that lend meaning, clarity, and emphasis. Many speeches and lectures are embedded in a full multimodal display. Good lecturers also use facial expression, gesture, and body motion to further convey meaning and affect. Moreover, lecturers frequently combine voice with additional media, such as slides from PowerPoint. Altogether, this is a rich multimedia experience that overpowers the expressive strength of written text.

For these reasons, and to meet the expectations of students and the university, lectures play an important role in T-560. Nevertheless, their limitations as an instructional medium are obvious. For some students (especially deaf students) they are, in their raw form, completely inaccessible. For many others the words are accessible because they can be heard and their meanings recognized, but they raise barriers of different kinds, stemming principally from high demands on linguistic and cognitive abilities, including memory, attention, and the amount of background knowledge they assume. We use multiple strategies in our efforts to overcome the limitations and differential demands that lectures present.

First, in deference to the first principle of UDL, we provide alternative representations of the lectures. We provide several types of alternatives differing in the kinds of problems they seek to address, the ease of implementation, and the kinds of technologies they require (from no tech to high tech). For example, the lecture's content is made available in alternate sensory modalities. The university provides sign language interpreters whenever there is a deaf student or teaching assistant in the class (as there has been for the last three years). Good interpreters not only capture the semantics of what they hear, but through body movements, facial expressions, and gestures, they capture the affect and stress as well. The lecturer also attempts to also orally describe visuals. At this time, this is the only real adaptation of the lecture provided for students who are visually impaired or blind.

Second, we videotape each lecture in its entirety and place the video on the course website where it can be accessed at any time. This permanent recording of the lecture is an alternative representation that has several uses. For many students it is a minor convenience to be able to access the recording of the lecture at any time of day or night, and a good backup if they are late or absent from class. For other students, the information in online lectures is much more accessible than the live version. Students for whom English is a second language, or students with a wide variety of language-based disabilities, for example, find that the linguistic demands of understanding a live lecture are steep. For some of them, the flexibility of the video version is superior because it can be reviewed at any time to fill in gaps, stopped and started to hear difficult segments repeated, and even replayed in its entirety. Finally, for other students, the length and passivity of lectures and their demand for sustained attention and concentration are significant barriers that render lectures ineffective. Lectures are inherently evanescent and impermanent. The linear, one-time-only stream of a lecture is highly demanding on concentration and executive abilities. Lapses are inevitable and create difficult-to-repair gaps in a lecture's structure and meaning. For some students, therefore, the online video presentation is especially helpful because it allows them to articulate the larger whole of the lecture into manageable chunks, or to replay segments that have been missed during lapses in concentration or attention. In truth, however, the videos of lectures are not used that much by the typical student in T-560. They are a fallback that is essential for some students, but way too time consuming, low in quality, and passive for most. It is interesting and important to note, for example, that in spite of all lectures being available on the course website (and thus very convenient for viewing anytime any where), students overwhelmingly come to class anyway.

Third, and perhaps most interesting, we collect student notes from the lecture and display them for everyone enrolled in T-560. This may seem both time consuming and redundant (especially in light of the online video availability), but we have found this very simple technique to be enormously beneficial, and a wonderful example of the unexpected benefits of universal design. While it is possible to have volunteer or paid notetakers as an accommodation for students with disabilities, we have found that to be unsatisfactory in many instructive ways. In brief, "professional notetaker" is a misnomer, given that notetakers are typically first-time students in the course and their own skills at making sense of things are highly variable. Since their background knowledge, interests, and learning preferences often differ considerably from those of the "disabled" student for whom they are taking notes, their notes are often poorly directed, sampled, or leveled. Instead, we have hit upon a very simple alternative. Each week, several students (in our case, five or six per lecture) are responsible for taking notes of the lecture, including whatever discussion takes place. Within several days after the lecture, they are required to send their notes to a teaching assistant, who posts them on the course website. The notes are then available to everyone, whether a student has a disability or not. While the notes are not graded, they are required as part of students' participation grades.

There are several unexpected benefits of this notetaking process. First, the notes are more universally designed than the lecture itself; that is to say, different students capture and express very different content from the lecture and they represent it in very different ways. In addition, despite being ungraded, students are highly engaged with the notes, responding to student notes in online discussions on the course website and using them as examples during class lecture. The variance in T-560 notes is astonishing. Some students post notes that are almost perfect linear outlines of the lecture. Some are very short and succinct with bullet outlines only, while others are much longer, more expressive, and expansive. Others are different in kind. For example, some students do not outline the talk at all and are much more anecdotal than taxonomic, capturing more of the "stories" of the lecture than its structure. That is only the beginning of the variation. Some students take very graphic notes instead of ones that rely primarily on text. Their notes range from doodles that accompany text, to heavy use of illustration and visual highlighting that clarify and connect parts of the text, to notes that are literally superimposed on the PowerPoint slides of the lecture, to full-scale visual representations of the main ideas and concepts in the lecture that have almost no words, just labels. The latter are often a big hit with other students, who find them immediately a strong complement to the outline view. With students' permission, we use Figures 1, 2, and 3 to show samples of student notes from the same lecture on strategic and motor networks; they illustrate some of the diversity of student notetaking in T-560.

A second benefit derives from the public posting of the notes. Students, seemingly already engaged with the notes, recognize that their notes are about to become public to their peers. As a result, they often enhance the notes in various ways: bringing in additional information, commentary, or questions; adding images or drawings; adding multimedia (like video or sound); or preparing the notes in a particularly cogent and clear way. We never have requested this kind of enhancement. Instead, there is a natural contagion of enthusiasm among the notetakers who, of course, view notes from the previous

Figure 1. Example of student notes displaying graphic handwritten style of notetaking.

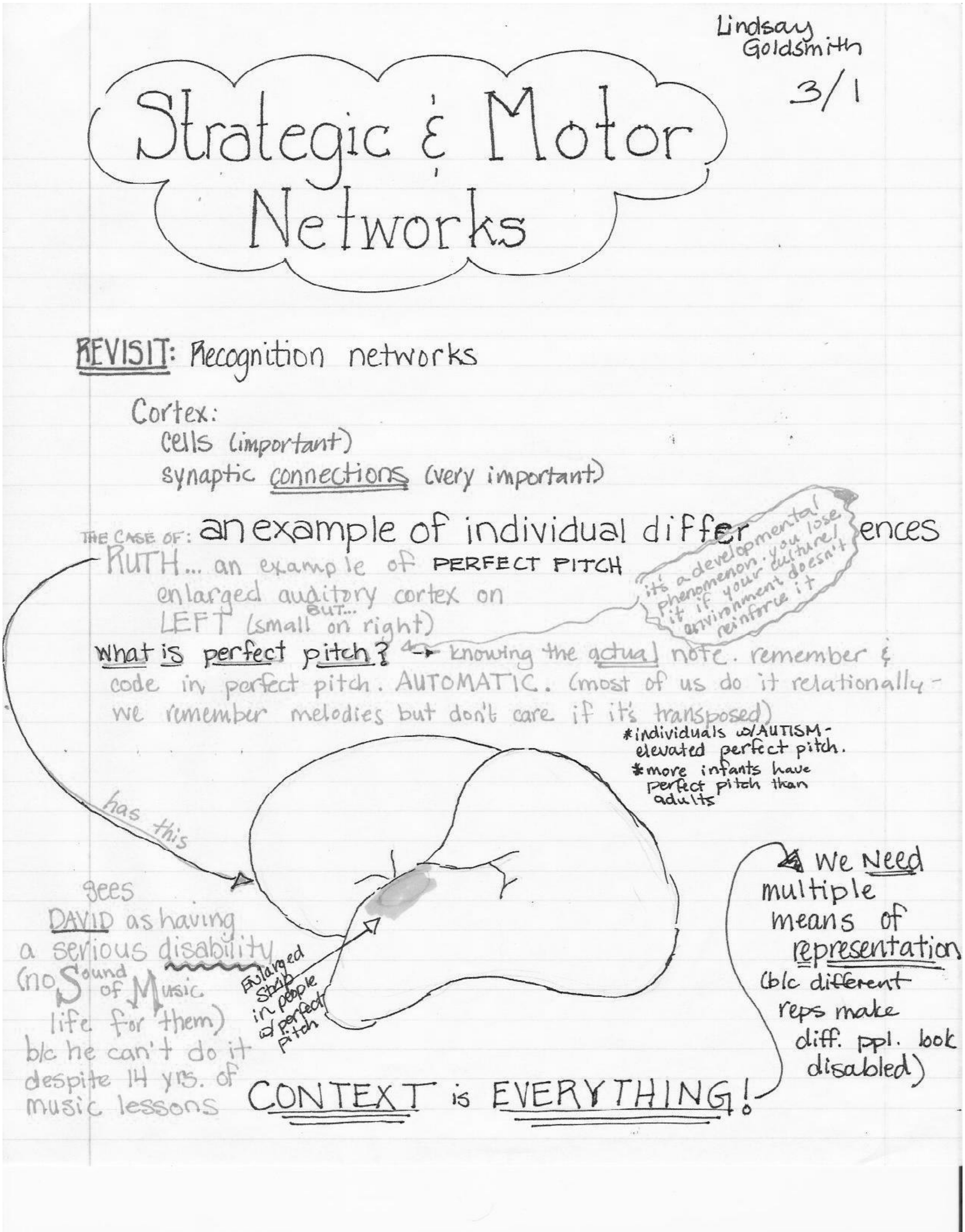

Figure 2. Example of student notes displaying notetaking with a traditional typed outline and bullet-point style.

T560 Notes - Individual Differences in Neural Networks: Strategic Networks
3/1/2005

- **Reprise: Recognition Networks** (review from last week)
    - Connectivity between neurons matters most in cortex (more than amount of neurons itself)
- **The Problem of Ruth: Individual Differences I: Perfect Pitch**
    - Perfect Pitch (a.k.a. Absolute Pitch): people with it have enlarged area (on left side) devoted to pitch (about 1 in 1000 people have it)
        - Person with Perfect Pitch recognizes voice (like all of us) but also knows what pitch it is
        - Automatic recognition—they don't think about it
        - They recognize when pitch is transposed
    - Issue of Disability
        - Ruth feels *not* knowing pitch is a disability—it seems so simple to her
        - Context is everything when thinking about disability
            - Course about interface between people and their contexts
                - E.g. other places in which Ruth has problems
        - Question arises: Is it all biology? Is it all learning?
            - Answer: It's impossible to tell
                - Perfect Pitch is a developmental phenomena; it needs to be shaped and molded; it's sculpted by the environment
                - More infants have Perfect Pitch than adults
                - Perfect Pitch is quite different among individuals in different populations
        - Meeting the Challenge of Individual Differences:
            - Provide Multiple Means of Representation
            - Pay attention to how we'll represent information: any single representation will not work well for everyone
- **Strategic Networks**
    - Frontal lobe
        - Six-layered, neocortex, pattern generation device; it organizes movement so that you can move intentionally; all about taking action; sends neurons so that muscles can move
        - Back section: prompts twitches, very small motor movements
            - When its damaged: some sorts of paralysis
                - Spastic paralysis: reflexes that are too strong
        - Second section: organizes twitches to make actual movement
            - When its damaged: unable to make skilled, intentional actions (e.g. shooting jump shot, walking, talking)
        - Prefrontal cortex: organizes movements/skills above into longer, strategic movements; intentional acts of planning
            - When its damaged: absence of prefrontal cortex leads to inability to use eyes strategically to answer different questions
    - Picture recognition:
        - Back part of brain recognizes

Figure 3. Example of student notes displaying a style of notetaking that mixes clip art graphics, Internet links, and typed text..

T-560 March 1, 2005
Last Week: Recognition Networks
This Week: Strategic and Motor Networks

The 1st Problem of Ruth
A story of individual differences

(pitch pipes)

David's wife Ruth has perfect pitch. (Try this Perfect Pitch Test to see if you do, too!) That means she codes musical notes 'in absolutes.' When a note is played, she can name it without having any other notes to relate it to. Her auditory cortex probably "lights up" more than David's. Compared to Ruth, David is *disabled* in the perfect pitch department, along with the other thousand (or ten thousand according to this Absolute Pitch website) of us 'relative pitch consumers' for every perfect pitcher, like Ruth.

Q: How does this story apply to UDL?
A: Because this class is about the interface between people and their contexts.

In the context of church Ruth's interface with singing/music/pitch makes her appear disabled, or at least unable, compared to David's interface with singing/music/pitch as he lifts his voice with gusto.

Questions to Consider
Q: How does perfect pitch change depending on the environment?
Q: Why would some people have perfect pitch and others not?
Q: Are there trade-offs or balances between abilities and disabilities?

lecture as a way of preparing to take their own. They learn, in fact, to take better notes by informally mentoring each other.

Lastly, the point of universal design becomes clear to every student quickly, as the kinds of notes they take and what they "learn" from a given lecture often differ greatly from the person sitting next to them. Even though the lecture conveys ostensibly the exact same content for all 93 students, its reception is highly variable. Students perceive, understand, and prioritize very different things within the same lecture. This is often especially interesting (and a big relief) to students who have been told they "cannot" take notes because of a disability (e.g., having a learning disability or brain injury, being deaf or hard of hearing). While initially dreading this aspect of the course requirement because of preexisting beliefs about what constitutes "good" or "acceptable" notes, they often quickly realize that their notes will be as "good" as their classmates' notes. Last year, one student told a T-560 teaching assistant that she felt more like a true member of the class, learned a lot about herself, and gained new insights into her learning disability and what it meant for her learning, simply because of the T-560 notetaking system.

Thus far, we have talked about three different representations of the lecture: an alternative sensory presentation, like ASL; a re-viewable alternative in the form of web-based videos; and multiple notes shared among students. There are many other ways to provide alternative means of support within a lecture. We will provide one more example.

Cognitively, a lecture places many demands on students. For example, a lecture's structure is generally much more implicit than its textual counterpart. Missing are the explicit reviewable divisions into visible chunks like sentences, paragraphs, and chapters; the structural support provided by explicit and multiple levels of headers; and the use of white spaces and page layouts to emphasize structure. Good lecturers use a variety of techniques to make their structure more explicit and memorable, and to reduce the cognitive load in other ways (e.g., by using a great deal more repetition than editors of written text would tolerate, by explicitly stating the structure of the talk early and often, and by explicitly summarizing where the argument has come so far).

In T-560, as in other courses, we seek to provide cognitive and structural supports during the lecture. PowerPoint slides, for example, are a nearly constant accompaniment. We use slides in two primary ways. First, the slides are used to clarify and make explicit the structure of the talk. Most teachers of public speaking rightly criticize the overuse of slides in "bullet point" mode, where speakers essentially read their slides to the audience, often to the detriment of content and meaning (for a discussion of these concerns, see Tufts, 2003). Even though we are sometimes guilty of that as well, PowerPoint slides are most frequently used in T-560 to introduce a new topic or to summarize a previous section. That is, they provide the structure, but not the substance of the presentation.

During the main part of lecture presentations, the slides are primarily graphic or visuals: They are an alternate representation of the content and a complement to it, rather than a restatement of what has been said verbally. In particular, we attempt to use slides that capture the power of graphic images over text, including the ability to clarify and emphasize relationships between facts, concepts, ideas, principles, and processes. The primary power of images is exemplified well in a graph. A quick glance at a graph provides a rich and explicit exposition of the relationships between several variables or sets of things. Providing that same exposition through words is extremely labor intensive, and often too opaque. Other images, a photograph or video, have the same privileged capacity to convey relationships of interest. For example, an elephant's size relative to a zebra's is much easier to convey in an image than in words. In addition, we try to provide a structural context within slides – a header at the top of a graphic slide, for example. The header is a reminder, an element of structure, to students that we are looking at examples of "good website design" or "the limits of sound." In a more subtle way than bullet points, in this way we hope to provide structural supports that help students follow and make meaning of the presentation.

These and other means are used to make lectures more accessible to a wide variety of students. In our impression, most students like these alternatives, whether or not they have any disabilities that require their use. In that way, they are good universal designs when taken as a whole.

Discussion Groups and UDL

Discussions are often seen as a supplement to lectures or a complement to assigned texts. For some students, especially students with learning disabilities, the format of small-group discussions is more accessible than lectures or books. The highly interactive nature of small groups (when facilitated correctly) overcomes the passivity of lectures and books, makes material more relevant and engaging for many, and provides the potential for complex active group-based construction of knowledge rather than simple delivery of information. For those reasons, and many others, it is beneficial to provide discussion groups as components in any course – both as a complement and as an alternative to the other media. Yet small group discussions are a limited medium for some students. With this in mind, we apply UDL principles to discussion groups using the approaches discussed below.

First, students may choose among different discussion groups offered during the week. In addition, all discussion groups are optional – students may choose any, all, or none, although it is one of several ways to fulfill participation requirements (notetaking, as mentioned above, is another). In practice, some students come to many sessions, some to only a few, and some to none. The sessions differ in several cognitively meaningful respects; however, we have noticed that some students base their choices on the entirely social aspects of who is in the group or who is leading it.

There are "review" sessions, where new information is not typically presented, but where students have an opportunity to ask questions about the material for the week, participate in guided review discussions of the week's content, discuss implications or highlights of the material, express concerns, and so forth. These are ideal for students who find the content of readings or lectures either too challenging or too abstract. It is also a good place for students to inquire about gaps in background knowledge they are missing (e.g., some students who are not K-12 teachers may want to know more about lesson plans when we talk about designing curricula).

An alternative is sessions that are called "advanced." In the advanced sessions, the teaching staff assume students have already read and understood the material for the week and, therefore, discuss something that extends or challenges that material, connecting it more deeply to other knowledge or ideas. In these sessions an additional relevant reading is assigned that is provocative, new, stimulating, controversial, or even contrary to material otherwise presented in the course. Students must read the extra reading before coming to class. Typically about 10 – 15 percent of students show up for these kinds of sessions in a given week, although about 25 percent of students participate in them over the course of the semester. These are ideal sessions for students who find the lectures or readings too elementary or concrete.

Another way in which the discussions differ is in the medium for participation. Each week students may choose to join either a face-to-face group or an entirely online discussion group (offered as a component of the course website). Students differ significantly in terms of the kinds of discussions they consistently prefer. Some students join only face-to-face groups, never participating online. Others choose just the opposite. And some come randomly or "attend" both types.

We have not done research to understand the basis of students' choices. Some things seem obvious though. Students with dyslexia tend to come to face-to-face sessions, rather than writing online. Students who are constitutionally or culturally "shy" seem to choose the online discussions. What is clear is that the medium very significantly biases student participation. Without the opportunity to participate in discussions online, many students are underrepresented in their ability to show what they know, or they experience barriers to engaging in meaningful dialogues about the course material.

By providing options, multiple means for those discussions, we have found higher rates and quality of engagement in these aspects of the course. In our review of the past year, we came to the conclusion that all our sessions, live and online, would be enhanced by providing specific topics or activities that made them more coherent. As a result, for next year, we will try to use the discussion sections to emphasize an alternative way of engaging in the course content by using case studies.

Textbooks and Universal Design for Learning

Books (and other texts) are not a promising foundation for UDL because they are inherently inflexible. The product of mass production, they are designed with a uniform display and identical content for every student. In addition, most books are delivered to colleges and universities in print, a technology that is particularly difficult to modify, and thus, to meet the needs of many students with disabilities. As a result, books as they are presently delivered create barriers rather than opportunities for many students. Nevertheless, they are popular in universities (and we like them for their virtues, not their liabilities), so in T-560 we use books. For the most part, we use books in typical ways: Three or four books are assigned and suggested for purchase, with others on a recommended list. Two are textbooks, and the others are trade books or topical readings on education, media, and neuroscience.

When the reading list is distributed, students notice one thing immediately - the two textbooks seem to cover the same exact topic of introductory cognitive neuroscience. Moreover, the syllabus recommends that students purchase and read only one of them. But which one? That choice is left to each student. This is the first place in the course where students typically begin to confront alternatives (while developing an understanding of UDL from a first-hand perspective). Some are charmed by the choice of alternatives, others become alarmed. For some, the fact that either book will suffice does not square with the ways in which they have been taught to use textbooks. While there is likely considerable overlap between the books, every student knows that there will clearly be topics, ideas, names, facts, experiments, or methods in one that are not included in the other. One of the books is even much thicker than the other, so how can one even think about buying the thinner one – for fear critical information is left out?

Students soon note, and we also point out, that the books are different not only in the content they present, but in the *way* they present the content. One book by Banich (2004) has a great deal more words (it is also much thicker). It is a highly literate, well-written and researched book that is authoritative and scholarly, with occasional illustrations. The main thrust is clearly the text. The other book, by Carter (1998), is highly visual, loaded with drawings and diagrams. It is a thinner book, with many fewer words but with many more diagrams, illustrations, color, graphics, and maps. Having noticed the difference, students are encouraged to buy the one that seems best for them. Typically, Carter's book sells a bit more, but many students buy Banich. Students are encouraged to borrow each other's books, to compare them and to get the best of both, and some do that. A few buy both books. Regardless, this first choice sets the stage for the course. It is not that either book is perfect, has the "truth" of cognitive neuroscience, or has the right way of presenting information for all students. Instead, students are confronted right from the start with the fact that they might not all like their information presented in the same way. It's a start.

Later there are other choices about books. One of the books, *Teaching Every Student in the Digital Age: Universal Design for Learning* (Rose & Meyer, 2002), is available at the bookstore and library as usual. With the permission of the publisher, the entire book is also available on the web absolutely free at http://www.cast.org. Nonetheless most students choose to purchase it in print. For most students, reading a whole book online is not a positive experience. The print version is more convenient, more readable in the long run, and more familiar. Most of the students in this class are adult graduate students, immigrants to the land of digital books instead of natives. However, some students who are very pleased to read the book entirely online. These students, students with dyslexia or students who are blind, for example, do not find that the print version is more convenient, more readable or more comfortable. For them it is much better to read the book online using a talking browser. Other students, like those with ADD/ADHD or those who are computer-savvy, prefer the online book because they enjoy exploring the format, especially embedded links, which foster connections to relevant material that may not be as easy to access through a print version.

Not all the course books are available in this alternative fashion yet. As a result, students who have dyslexia typically approach the Disability Services Office to scan the printed books into digital versions that they can use. This is an unfortunate, time-consuming, and expensive workaround to overcome the limitations of print, but that will soon change.

Earlier this year, the U.S. Department of Education endorsed, both houses of Congress passed, and President Bush approved a revision of IDEA that included a new policy: the National Instructional Materials Accessibility Standard (NIMAS). NIMAS stipulates that publishers must provide a digital source file of their printed textbooks to a national repository at the time of distributing print versions. Furthermore, states must distribute accessible versions of those source files to their students in a timely fashion. NIMAS is valuable because it specifies the format (an XML base with DAISEY tags) in which the textbooks must be provided, making it vastly faster and easier to generate many types of accessible and digital versions, and the format is consistent for all publishers and for all states and districts.

Officially, NIMAS only applies to preschool, elementary, and secondary education. However, the popularity of NIMAS among states and publishers alike has led many colleges and state systems, as well as publishers, to consider adopting the NIMAS standard for postsecondary use as well. However, these ideas have yet to be implemented in any formal or systemic way. Soon, we believe that there will be readily available textbooks in both print and digital accessible versions.

Multimedia, the Course Website, and Universal Design for Learning

Text and textbooks are a limited presentation medium. In the T-560 course, we include a richer set of media as alternatives. The use of video for lectures is an example, but the simplest expansion of media comes from using the web as the basic skeleton for the course.

The course website is central to the course in many ways. It serves as a frame that holds the syllabus, the assignments, the discussion groups, the projects, the class notes, the class videos, the PowerPoint slides for the lectures, and much more. For each week, there are also links to many websites that are presented as additional representations of the topic for the week, or as scaffolds and supports for student learning.[2]

While, in general, there are many low quality materials on the web, some websites are extremely informative and relevant to our class. An advantage of websites is the rich set of media out of which they are constructed. As an example, one of the course lectures draws heavily on understanding optical illusions. While, there are typical examples of illusions in both textbooks, there are several extraordinary websites devoted entirely to understanding illusions. These websites have extensive collections with accompanying explanations. Moreover, the range of illusions is far more extensive and dramatic than those available in print. For example, illusions of movement or sound cannot be captured in text. During the lecture, which is always conducted with a live connection to the web, some of these more dramatic illusions are exhibited and discussed.

In the course website, the multimedia syllabus conveys not only the text "readings" for the week, but also the websites and other media, all available for easy access through simple clicks of a mouse. These alternatives are mildly engaging for some students, but for others this chance to explore course ideas in a broader and richer context is very important. In fact, for some students who were born in a different generation than their professors, this use of contemporary media seems essential for relevance and comprehensive understanding.

Assessment Methods for the Course

It is not enough to use the framework of UDL only when considering how to present and teach methods information or skills. It is also essential to consider UDL as a framework to guide the design of another critical element of instruction: assessment. In considering assessment, we will focus on the second principle of UDL: providing multiple means of action and expression. While the other principles are also part of assessment, for brevity we will focus on the obvious fact that assessment draws heavily on the ways in which students are required to demonstrate and express what they know. From a UDL perspective, it is essential to provide multiple means for that expression.

There are many assessment techniques, the choice of which should be aligned with, and constrained by, the goals of the course. In our course, we want to develop students who are not only able to recognize UDL in practice, but who can also express that knowledge in action. Whether they are designing a curriculum or a workshop, choosing from among a number of curricular options, or preparing to teach a single unit or lecture, we need to know whether they can effectively apply what they have learned. Is it usable knowledge? Administering multiple-choice tests or essay questions is not likely to be an adequate measure of those abilities, nor is writing a traditional paper about how they might apply what they have learned. As a result, we require that students complete two projects on which they are graded.

Midway through the course, students prepare and submit a midterm project that requires them to review the research literature on one type of learner (of any age level, including adults) and to create a website. Students are encouraged to choose an atypical learner as their focus. While "atypical" is usually associated with a disability of some kind (dyslexia, autism, ADD/ADHD, Turner's Syndrome, William's syndrome, etc.), past projects have focused on other types of atypical learners, including those for whom English is a second language and students with gender dysphoria. Students research current neuropsychological literature to identify what is known about the underlying neurology of that type of learner, and to articulate their resulting strengths and weaknesses for that learner in a specific subject or educational setting (e.g., dyslexic students in a 5th-grade science lab).

Traditionally, the results of such student research is presented via a 10-page paper. However, the second principle of the UDL framework encourages greater flexibility in the means students can use to express what they have learned. As a result, students in T-560 can not only use text, but also images, sound, video, the web, and so forth. To stimulate their choices, we artificially limit the word count to approximately 1,500. We do that because most students, left on their own, tend to limit themselves to text because it is most familiar to them as an academic medium; with a low word limit, they must rely on alternative means to convey very complex reviews of neuropsychological research and their conclusions. For some students an expansion of possibilities is a bit threatening, for others the broader palette is very appealing.

When finished, all students must submit their projects in the form of a website that then becomes part of an online learning network where all students' websites are linked up to each other. This manner of submitting their work is very challenging for some students, and many have never created anything on the web before. We have nonetheless chosen to use the web, rather than paper, as the vehicle for presentation for several reasons.

First, the web provides a rich and flexible foundation for using multiple media. Students can use text but also a rich variety of other media. Second, the web provides a way for students to learn from each other's work. Whereas papers have a limited audience of the professor or teaching assistant, the projects on the website can be accessed by all members of the class. Not only is this more motivating for students, it is more instructive. Each year we see tremendous learning derived from this ability to view each other's work. In fact, we now emphasize this type of collaborative learning by encouraging students to link their projects to those of other students. Particularly in the final projects, in which students design a lesson or curriculum that considers the profile of the learner in their first projects (and reflects the principles of UDL), students take great advantage of other students' work as part of their background research for their own projects. But even more apparent is the explosive effect of particularly strong projects, especially ones that take advantage of the multiple media. The contagion of "best practices" is easily apparent, as high-quality projects serve as terrific, highly relevant models to emulate and learn from.

How are these projects, so public and non-traditional, graded? Each year students ask anxiously if we will grade on presentation or layout (as opposed to content). Most hope that we will not, primarily because they realize that some students in the class have highly developed skills as web or media designers. (There are students in the class who are majoring in media design.) Thus, some students may be at a considerable advantage in their presentation skills. This realization usually sparks an important dialogue in the class. Inevitably some students, usually students with dyslexia or English as a second language, raise the opposite point of view, hoping that presentation will indeed "count." For them, the increased palette has "leveled the playing field" for the first time in their academic careers, and they are delighted to finally have an outlet that is more accurately reflective of their abilities.

Eventually, they learn that presentation does count. Certainly, we are forgiving for beginners, but we stress that even beginners can make good choices about the kinds of media that are optimal for expressing different kinds of knowledge. And we provide, in a UDL way, many different ways in which students can get support in making their presentations effective; that is, multiple ways to support expression.

Three types of support are customary. First, we provide plenty of models. For the first project, models are typically provided from the previous year's class. For the second project, there are plenty of models from the first projects of their peers. Second, we provide multiple scaffolds. We offer labs or sections where students can come to learn the basics of both web design and the use of databases to find relevant literature. This year for the first time, we encouraged the students with advanced web design skills to offer these labs (as part of their participation credit), which was a big hit for both instructors and students. All the labs are at different skill levels so students can learn from any level of prior knowledge. We also encourage students to work collaboratively, and they do, even though they each are responsible for their own website. Students who are skilled at media design, even though they may not be knowledgeable in neuroscience or skilled in writing, turn out to be very popular as peer collaborators with educators and researchers who may know how to read a web page, but have never designed one. Complementarily, students who have excellent backgrounds in education, neuroscience, or research are popular collaborators for media designers struggling with the class content. The two projects - presenting research and then planning a lesson - draw on the varied strengths of students in the class, giving everyone a chance to have background knowledge rise to the fore.

Affect and Engagement in T-560

From a UDL standpoint, there is a final concern: Does the course succeed affectively, engaging the students? Does it engage different kinds of students? Does engagement sustain itself into changes in practice? Overall, there are indications that the course engages a reasonably broad range of students. For one thing, the course is popular. This is especially notable because it requires a considerable amount of work in difficult subjects, the course is not required for any degree concentration, and there is no special education major at Harvard. What attracts students?

We believe that one of the significant attractions of the class is its attempt to respond to individual differences, providing multiple ways of presenting information and allowing students to respond. Of particular importance, especially for adult learners, is the ability to make choices (e.g., Cordova & Lepper, 1996).

In the course, as we have noted, students experience choice in almost every arena: choices in the textbooks they choose to read, the kinds of media they prefer to learn from, the timing and level of discussion groups, the media mix they use for their projects, the format for discussions, the amount of support they prefer, and the ways to interact with materials. For some students there are still not enough choices, and for some there are too many. But overall, the mere availability of choice is a tremendous source of attraction and motivation in the course.

There is a second way in which choice is important, and it addresses the faculty and teaching assistants. Because there are multiple means of interaction in the course, there are choices for the faculty as well. At the beginning and throughout the course, we emphasize the different areas in which we as members of the teaching staff have strengths and weaknesses (in content areas, web design, pedagogical strategies, etc.). This "distributed intelligence" eliminates having to be everything to everyone. It also models for students the value of collaborative teaching and learning. To some extent, the instructors choose the kinds of interactions with which they are most comfortable, and at times they choose situations where they will be challenged to learn relatively new information or skills with the support of other instructional staff, placing them in the best positions to succeed and to feel engaged.

Lastly, it is important to emphasize a secondary benefit of universal design. Because there is a richer media mix in the course than in many others, there are opportunities to specialize. It is very clear that, over the last five years during which the alternative media became more prominent, the lectures have become better. Essentially, just as radio differentiated from television and became more popular in the process, the lectures have been able to differentiate themselves from the other course media. The lectures are used less for information dispensation and more for teaching, modeling, emphasizing, and connecting. They are used more for the kinds of things for which they are optimal.

Conclusion and Recommendations

There are two broad kinds of solutions for addressing the "problems" of individual students, including those with disabilities. On the one hand, the problems can be considered "individual" problems (e.g., the student has a disability that interferes with his or her ability to access the content of the course, to express knowledge, or to engage optimally in it). Such a view fosters solutions that address weaknesses in the individual. On the other hand, the issues can be considered "environmental" problems in the design of the learning environment. For example, the typical overreliance on printed text for presenting content and evaluating students clearly, and differentially, raises barriers to achievement for some students while privileging others. Such an environmental view fosters solutions that address the limitations of the learning environment rather than the limitations of the student, while making the student less of a problem, and more a part of diversity within the course. The advantage of such universal solutions is that, as with such approaches in built environments, they are likely to be useful for many individuals; built once, applied many times.

We believe that both approaches are important from a pedagogical standpoint. In their intersection, moreover, we will find solutions that are not only more economical, but also more ecological. They reflect the fact that so-called disabilities always reflect mismatches between the environment and the individual. Right now, we believe that universities place too much emphasis on the disabilities in students, not enough on the disabilities in the learning environment. Accommodations and access issues are largely addressed on an individual basis, rather than on the level of courses, departments, or universities. Universal design presents other options and perspectives on access that will ultimately benefit all students, disabled and nondisabled.

Endnotes

1. Additional resources for teaching and learning about UDL may be found at CAST's website at http://www.cast.org. The book *Teaching Every Student in the Digital Age: Universal Design for Learning* (Rose & Meyer, 2002), which provides background for the principles and applications of UDL, may be found on the CAST website in an accessible format and free of charge. The website includes additional resources and templates, including PowerPoint presentations to assist individuals who are teaching UDL to faculty or other interested parties.

2. The website for the course described in this paper may be accessed at http://my.gse.harvard.edu/icb/icb.do?course=gse-t560. Some sections of the website are not available to the general public to protect copyrighted material and the privacy of students who have contributed their work and words.

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Parent Brief

Promoting effective parent involvement in secondary education and transition

April 2005

Universal Design for Learning and the Transition to a More Challenging Academic Curriculum: Making it in Middle School and Beyond

by Beth Casper and Deborah Leuchovius

***Universal design means that environments and curricula are designed, right from the start, to be flexible and useable by students of widely varying abilities*.**

The transition from elementary school to the secondary system—middle school and high school—is a traumatic time for many students and their families. Any child can have difficulty with the transition. However, students with disabilities who need accommodations or adapted curricula—even those who have had successful elementary school experiences—often have more difficulty. With an increased national focus on standards-based testing and curriculum, students with disabilities face even greater challenges ahead. A new approach to teaching and learning can help middle and secondary school teachers more effectively accommodate different learning styles. This approach, referred to as "universal design," holds potential for easing the transition to middle school and helping all students achieve academic success in their secondary school years.

New Challenges for Middle School Students

The transition to middle school is a major leap for most students. Instead of one classroom, one teacher, and individual attention, students typically find themselves in a multi-period, multi-classroom school that feels much more impersonal. Middle schools are usually larger than elementary schools, and students must adjust to having numerous teachers each day instead of one primary classroom teacher.

In secondary school, teachers are responsible for teaching several classes each day, each with a different group of students, making it harder for them to get to know each individual. Curriculum is taught at a more rapid pace, assignments and homework are more time-consuming and difficult, and high-stakes testing puts increased pressure on students. It's easy to understand how students can feel lost in the shuffle.

When students enter the demanding academic environments of middle school, and later high school, any lack of prerequisite skills becomes more obvious. For students with disabilities, this transition can be even more challenging. Many students receiving special education services have been included in general education classrooms in elementary school, but have not actually kept up with their peers. Though present in the same classroom as their peers, many special education

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students are not expected to learn the same curriculum as their peers or do not receive the individualized support they need in order to learn more challenging subject matter. As a result, many children with disabilities are not entering middle school prepared for such tasks as researching and writing longer, typed papers; listening and note-taking during hour-long lectures; remembering up to 80 facts per test; or handling the responsibility of more homework every night.

The recent focus on standards-based curriculum (see side panel) and testing has created a more challenging education environment for students with disabilities. Students are asked to think and inquire more critically about information, rather than just answering a teacher's question with simple facts. Some students with disabilities may need more individualized instruction, adapted goals, or alternative assessments to meet newly established state content standards.

In general, special and general education teachers have few opportunities to collaborate with one another or learn about including students with disabilities in new standards-based curricula (Dailey, Zantal-Weiner, & Roach, 2000). Nor have content standards or secondary-level curriculum materials of academic subjects such as biology or social studies been designed with students with disabilities in mind. Most classroom curricula rely almost exclusively on printed text and are not easily accessible to students with sensory, physical, emotional, or cognitive disabilities who need alternative ways of accessing and processing information

In addition, teacher guides developed by textbook publishers do not typically include suggestions for how to accommodate students with disabilities. Some schools and teachers provide adaptations and use assistive technologies to help students use existing materials but these adaptations can diminish the concepts and skills of the curriculum, offering a different, diminished curriculum. At the same time, standards-based assessments are now required in most states for grade promotion and graduation. All of these factors combine to make it difficult for many students with disabilities to meet

cur-ric-u-lum
noun, plural

cur-ric-u-la
or
cur-ric-u-lums

What are content standards?
Content standards specify what children are expected to know and be able to do in academic subjects. Academic content standards should "contain coherent and rigorous content and encourage the teaching of advanced skills" (No Child Left Behind Act, 2002).

What's a curriculum?
The curriculum is the plan made for guiding learning in schools and the implementation of those plans in the classroom (Allen Glatthorn, 1987).

What's a standards-based curriculum?
A standards-based curriculum is one in which the plan guides the learning of the content standards.

higher academic standards in middle school and eventually to graduate from high school with a standard diploma.

Since the reauthorization of the Individuals with Disabilities Education Act (IDEA) in 1997, school districts have been responsible for providing access to the general education curriculum for students with disabilities. By promoting access to the general education curriculum for students with disabilities, the law aims to improve learning, increase graduation rates, and better prepare students with disabilities for postsecondary education, employment, and a fulfilling adult life. Universal design is a strategy that can help secondary school teachers teach standards-based general education curricula to students with disabilities more efficiently and effectively.

Universal Design and the Transition to Middle School

The use of universal design principles in middle school and high school settings has great potential to benefit both students and teachers. It is an approach that makes it easier for teachers to accommodate different learning styles. Alternatives are built into the curriculum instead of developed or added on by teachers after students falter. The approach allows students with a broad range of abilities to learn and succeed—without placing an extra burden on teachers to adapt or create new materials for students in each of their classes.

Universal design is a generic term describing design that is intended to "simplify life for everyone by making products, communications, and the built environment more usable by as many people as possible at little or no extra cost" (Center for Universal Design, 1997). The basic idea behind universal design is that environments and products should be designed, right from the start, to meet the needs of all users rather than just an "average" user. In architecture, universal design has become well accepted. It is now routine to include ramps, curb cuts, and automatic doors in new construction because it is more efficient to design structures that are usable by as many people as possible from the beginning instead of adapting a building for diverse users later.

The concept has also been applied in fields other than architecture. For example, television captioning was first only available to those who purchased expensive decoder boxes. Later, decoder chips were built into all televisions, making captions universally available. Although designed for individuals with hearing impairments, captioning has proved to be popular with many users such as patrons of noisy restaurants, airports, and health clubs; English language learners; parents with reading-ready children who watch TV; and couples who have a TV set in their bedrooms yet want to go to sleep at different times.

Universal Design for Learning (UDL) is a term used by the Center for Applied Special Technology (CAST) to describe its work on curriculum design and access to curricula. Just as universal designs in architecture benefit all users, UDL benefits all students. The aim is to create curricula that are flexible enough to challenge the most gifted students, students struggling below grade level, and everyone in between. It does this by providing students with alternative ways to explore content, using multiple approaches at various levels of complexity. The goal is to meet each student at his or her current ability level, allowing him or her to advance to more challenging content at an individual pace. Because flexibility is built into the curriculum

A Range of Options

and the environment, UDL helps each student to participate and succeed even when a teacher is less familiar with the individual needs of each student.

Universal Design and Students with Disabilities

For students with disabilities, this approach has great potential. Students with disabilities, whether sensory, physical, emotional, or cognitive, may need alternative ways of accessing and processing information. UDL is a strategy schools can use to provide students with disabilities with access to more challenging course content; meet the legal requirements of IDEA; master state content standards; and develop the academic, study, and interpersonal skills needed to succeed in postsecondary education and employment.

How does is it work? Universally designed instructional materials and activities present students with a range of options for learning. Alternative activities allow individuals with wide differences in their abilities—to see, hear, speak, move, read, write, understand English, pay attention, organize, engage, or remember—to achieve learning goals. Information is presented to students through multiple means such as audio, video, text, speech, Braille, photographs, or images. Likewise, UDL allows students to use multiple means to express what they know through writing, speaking, drawing, or video recording.

Advances in technology have made some universal design strategies much easier to implement. Teachers have access to computers, software, assistive technology, and other tools that can adapt the curriculum to suit a child's learning style. For example, textbooks and other reading materials can be made available in a digital format that includes audio, captions, and audio descriptions of visual images and charts.

However, UDL is not only about including technology in the classroom. During the last 20 years researchers have identified a number of effective strategies that teachers can use to help all students in their classroom. The Institute for Academic Access, for example, provides information in its online library about strategies that teachers can use to help students of diverse abilities improve important academic skills such as understanding concepts, organizing information, and detecting and correcting errors in their written work.

Examples of Universal Design for Learning

- If a student learns best through listening, he or she can use a computer to read stories and information aloud, or to pronounce new words.
- If a student learns more easily with large print, curriculum materials can easily be provided in this format.
- If a student can explain things best by using word processing software and a keyboard rather than using pencil and paper, then that will be the method of choice.
- If a student struggles to identify the most important points or organize information, he or she can use a computer program that helps students learn by doing.

The Center for Applied Special Technology (CAST)

Technology and Teaching Strategies

Straightforward teaching strategies that can make information accessible to students with learning or cognitive disabilities include summarizing big ideas, repetition, practice, explicitly stating goals, and giving explicit instructions. Teachers can remove supports as students become more proficient. Universal design also incorporates simple physical accommodations such as making sure that every student has a clear sight line to the teacher and the blackboard; that equipment used for learning should be easily adapted for left- or right-handed use; and that materials should have clearly labeled instructions with symbols as well as words.

The Future

While such techniques are neither esoteric nor difficult to implement, universal design is a new concept for many educators as well as parents. Parents may know about universal design before teachers at their child's school. Parents know that it is hard to watch their son or daughter struggle in school when he or she is capable of learning more challenging material if given more individualized instruction. By educating teachers and staff as well as school board members and administrators about the concept of universal design, parents can help shape the future of inclusive secondary education.

What can parents do to help implement UDL approaches in the classrooms?

1. Ask teachers if they are familiar with the concept of universal design for learning or if they are currently using universally designed curriculum in their classroom.

2. See that related goals are incorporated into a student's IEP so that he or she can learn the same content as their peers. For instance: Discuss how members of the IEP or transition planning team can help general educators understand and implement these concepts in the classroom.

3. Advocate with local school boards and state departments of education for policies that require newly purchased textbooks and curricula to be fully accessible to students with disabilities by incorporating UDL principles.

Universal Design for Learning: Education Policy for the 21st Century

The U.S. Department of Education has taken an important step toward guaranteeing that students with disabilities have equal access to textbooks. It has sponsored the development of voluntary guidelines, called a national file format, for textbook publishers to convert printed materials into electronic files. Several states led the way by enacting legislation requiring that newly purchased textbooks be universally designed. Right now, however, each state has differing requirements for textbook publishers—some want electronic files in HTML and others want it in Microsoft Word. A national file format will make it easier for textbook publishers to produce, and more students to access, universally designed curriculum materials. Information on state legislation relating to accessible instructional materials can accessed from http://nimas.cast.org/about/resources/index.html.

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Resources on UDL:

- The Center for Applied Special Technology (CAST): *www.cast.org*
- PACER's Simon Technology Center: *www.pacer.org*
- The National Center on Secondary Education and Transition: *www.ncset.org* and *http://www.ncset.org/topics/udl/?topic=18*
- The Institute for Academic Access: *www.academicaccess.org*
- The University of Kansas Center for Research and Learning: *www.ku-crl.org*
- National Center on Accessible Information Technology in Education *www.washington.edu/accessit*
- The National Instructional Materials Accessibility Standard at CAST: *http://nimas.cast.org*

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What Algebra and Biology Students Have to Say About Universal Design for Learning

By Larry Kortering, Terry McClannon, and Patricia Braziel

Introduction

Success in general education settings is an increasingly important goal for all students, including those identified as having mild disabilities (Cobb Morocco, 2001). The No Child Left Behind Act (NCLB) of 2001 introduces higher performance standards for all students in the general education curriculum. This situation has become especially critical at the high school level as students must succeed in their courses in order to earn a standard diploma, which is required to access most forms of postsecondary education. Meanwhile, the majority of students with learning disabilities continue to spend most or all of their time in the general education classroom at the secondary level (Office of Special Education Programs, 2004). A similar though less pronounced pattern is true for students with other mild impairments, including those with emotional or behavior disorders and those receiving services under Section 504 of the Rehabilitation Act of 1973 (Office of Special Education Programs, 2004). Finally, the evolving labor market has fewer career options for individuals lacking a college education or a standard high school diploma.

Universal Design for Learning

The concept of universal design for learning (UDL) has been emphasized to improve how students with mild disabilities perform in general education (Hitchcock & Stahl, 2004; Scott, McGuire, & Shaw, 2003). Traditionally, content in the general education setting at the high school level has been inaccessible for many students, especially those with disabilities. Typically classroom teachers use course materials like standard textbooks and related support materials to present the curriculum (Pisha & Coyne, 2001), use teacher-centered instruction as the main format for delivering course information, and emphasize the reproduction of basic facts or ideas (Cobb Morocco, 2001). Furthermore, the classroom setting is driven by state-mandated curriculum and final examinations that put considerable pressure on teachers to cover the prescribed curriculum in a timely manner (Hagborg, 1999). Not surprisingly, many students find such settings to be uninteresting (Czikszentmihalyi & Larson, 1984) and frustrating (Kortering & Braziel, 2002; Higgins, Boone, & Lovitt, 2002).

According to the Center for Applied Special Technology (2005), "a key premise of UDL is that curriculum should include alternatives to make it accessible and applicable to students with different backgrounds, learning styles, abilities, and disabilities in widely varied learning contexts" (p. 1). UDL does not imply that one size fits all; rather, it recognizes the unique needs of each learner. UDL principles help educators design their instruction to help more students have better access to the curriculum and thus an opportunity to succeed (Pisha & Coyne, 2001). In some cases, experts have linked UDL to technology-based interventions (Rose & Meyer, 2002), while others have suggested a broader approach inclusive of how teachers structure learning and engage students (Howard, 2003; Scott, McGuire, & Shaw, 2003). This study focuses on the broader definition of UDL.

This study's findings illustrate how students perceive individual interventions anchored by three key UDL principles—multiple ways of representing course content, multiple options for student expression and control, and multiple options for engagement and motivation (Blamires, 1999). These individual interventions were used in standard-diploma track high school algebra and biology classes.

Settings

The study setting included two high schools in adjacent counties in North Carolina. High school A has about 2,400 students, including 12% African-American, 4% Hispanic, and 4% Asian, including Hmong students. High school B serves 1,400 students, with 5% who are identified as ethnic minority (African-American and Hispanic). The schools have, respectively, 20% and 22% of their students eligible for free or reduced-cost lunch. These statistics may underestimate actual poverty rates, because eligible students often fail to participate in free or reduced-cost lunch programs. Both high schools have strong academic reputations, as evidenced by being in the state's top 25% of end-of-course test performances.

Team participants included six algebra and five biology teachers. The teachers taught from one to three classes of standard-diploma track algebra or biology. Their class sizes ranged from 12 to 31 students, with an average between 24 and 27 students. Some teachers used as many as six UDL interventions, while others used none. The types of UDL interventions in algebra classes included:

- The teacher created a series of PowerPoint presentations to teach students how to better use the TI-83 calculator.
- The teacher used a laptop computer, video projector, and software for Algebra 1. The software illustrates the concept of slope and provides visual examples and opportunities for interaction for the students.
- Students learned to recognize and identify algebraic properties through a game. Students are in one of five groups, designated by a color, and each group has a set of properties that correspond to the team's color. A game format was used to test for student understanding.

The types of UDL interventions used in biology classes included:

- Students worked in small groups. Each group has a topic sheet with specific instructions on what the group is to teach to the other groups. After given the time to plan a presentation, the group was videotaped while teaching the class. These videos are then shown to classmates for review.
- Polling software was used to assess an applied genetics unit. The software allowed students to score answers with a remote control; answers were automatically tallied and displayed on a projector.
- The teacher developed a Web page with notes, test reviews, and other class information. Student accessed the Web page from home or outside of class.

As part of a federal grant for UDL at the high school level, teachers participated in from two to four full-day training sessions. The training provided each team of teachers with the technology, including a laptop computer, video projector, digital camera, and camcorder. It also gave the teachers hands-on use of the technology and practice of UDL-related resources in the classroom (e.g., developing instructional movies with the camcorder). Sessions two through four focused on incorporating Internet-based curriculum resources, conducting follow-up work with the new technology, and working in teams to develop specific UDL instructional interventions. These sessions also included a review of the concept of UDL and provided practical applications for their settings. Teacher participation was voluntary as was their decision to use UDL interventions.

Student Participants

Participants included 320 students (100 algebra and 220 biology) including 18 (6%) identified as learning disabled (LD), 6 (2%) labeled as behavior disordered (BD), and 4 (1%) labeled as mildly mentally handicapped. In addition, 12 (4%) student participants were identified as attention-deficit disordered with or without hyperactivity. Participants were exposed to one to six different interventions depending on their teacher and class setting.

Data Collection Procedures

Participating students provided feedback directly after being exposed to a UDL intervention (see Table 1). Each of 18 interventions (4 algebra, 14 biology) took place in a standard high school class (16 of the interventions) or computer lab (2 of the interventions). Students completed a survey at the end of each class in which a UDL intervention took place. There were 709 responses (189 algebra and 520 biology). Response data were then recorded and provided to the individual teacher. At the end of the year, each teacher received a copy of all the interventions and student responses for their content area.

Findings

The findings included responses from both closed-ended and open-ended questions in the survey.

Closed-Ended Survey Results

A Likert scale of one (strongly disagree) to five (strongly agree) was used to evaluate participants' perceptions of the UDL activity (see Table 1). Participants also indicated whether or not they would like to have access to more UDL interventions.

Across the five items, algebra and biology students reported strong levels of effectiveness, utility, and satisfaction related to the UDL interventions compared to their other academic classes. Both groups also consistently reported learning important and useful information, staying on-task, and working hard.

Table 1. **Student Evaluation of UDL Interventions**

Students rated their perceptions of the UDL lessons using the following scale:
1 = Strongly Disagree 2 = Slightly Disagree 3 = Unsure 4 = Slightly Agree 5 = Strongly Agree

In comparison to my other high school academic classes…

Algebra	*N*	Mean	Median	SD
Today's activity was more enjoyable.	189	3.84	4.00	1.18
I learned more important information today.	189	3.97	4.00	1.03
I learned more information that was useful.	189	3.94	4.00	1.11
The information I learned will help me more on the end-of-course exam.	189	4.22	5.00	1.02
I stayed more on-task for today's activity.	189	3.80	4.00	1.21
I worked harder today.	189	3.76	4.00	1.20
Would you like to see more of these interventions? Yes: 175 (93%)				

Biology	*N*	Mean	Median	SD
Today's activity was more enjoyable.	520	4.30	4.00	0.86
I learned more important information today.	520	4.31	5.00	0.91
I learned more information that was useful.	520	4.17	4.00	0.91
The information I learned will help me more on the end-of-course exam.	520	4.39	5.00	0.88
I stayed more on-task for today's activity.	520	4.51	5.00	0.73
I worked harder today.	520	4.48	5.00	0.81
Would you like to see more of these interventions? Yes: 458 (88%)				

In addition, an average of 90% across both groups reported wanting access to more UDL interventions.

Open-Ended Survey Results

A series of three open-ended questions helped elicit participant perceptions of the various UDL interventions. Table 2 lists these questions and a description of key themes. In order to be recorded in the table, the themes had to account for a minimum of 15% of total responses for the given question. The sample items that represented each theme were randomly selected.

Students in both general and special education reported very favorable views of UDL interventions. For example, about 90% of all participants expressed an interest in receiving more UDL interventions. Furthermore, the interventions were consistently rated as better (e.g., slightly or strongly agree) than what they experienced in other academic classes. Finally, the open-ended responses suggested that UDL interventions help students to learn and to use technology as an effective learning tool. In contrast, many students could not identify a "worst" part of the UDL interventions, and a majority of participants offered no recommendations for improving them.

A second implication of the study's results is that UDL is best viewed as a tool for changing how teachers think in terms of curriculum access and student success. The study findings showed that high school teachers often are reluctant to change their teaching style, instead preferring to maintain their established routines and behaviors. These findings also suggest that high school teachers may not adopt an innovative strategy unless they redefine it to fit their needs and situation; the goal of better access may not be shared by all high school teachers. Finally, further research is needed to determine whether students in the UDL courses score better on end-of-course tests.

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Table 2. Key Themes and Sample Response Items

	Question/Theme (n and %)	Sample Response Items
	What was the best part of the UDL intervention?	
Biology (*n* = 589)	Instructional activity (134 or 23%)	• "That we do some activity that helps us;" • "The fact that we got to teach and write on the board;" • "I like this because we got to make a hands-on model;" • "Hands-on stuff;" • "The lab;" and • "Getting to build it."
	The technology (130 or 22%)	• "The PowerPoint presentation;" • "Using the remote controls to answer questions;" • "I could see what I already knew; the PowerPoint was cool;" • "The printable notes from Web site;" and • "Easy access to notes."
	Successful learning or enjoyable learning (84 or 16%)	• "Clarified the steps of mitosis;" • "It made sure I understood it perfectly;" • "It helped me understand what goes on;" • "It helped me visualize the process;" and • "I actually understood what I was doing."
Algebra (*n* = 189)	Successful at learning (47 or 25%)	• "Learning how to do exponents;" • "Learned new stuff;" and • "Learned what you showed us."
	The technology (30 or 16%)	• "Getting on the computer and learning;" • "Learning about the computer;" and • "The computer-learning thing."
	What was the worst part of the UDL intervention?	
Biology	Instructional activity (169 or 29%)	• "It went slow;" • "Watching other PowerPoints;" • "Took too long;" • "It took everyone too long;" • "The number of cards we had to do;" and • "All of the assignments were a little tedious."
	No worst part (145 or 25%)[1]	"No worst part;" "Nothing;" and "None."
Algebra	No worst part (94 or 50%)[2]	"No worst part;" "Nothing;" and "None."
	Instructional activity (38 or 20%)	• "I already knew how to do it;" • "Doing so many examples;" • "I did not understand how you did fractions;" and • "It was boring listening to teacher."
	Do you have recommendations for improving the UDL intervention?	
Bio	No ideas (325 or 63%)[3]	"No worst part;" "Nothing;" and "None."
Algebra	No ideas (108 or 57%)[4]	"No worst part;" "Nothing;" and "None."
	Change instructional format or routine (37 or 20%)	• "It's a great activity but show more on how to do it;" • "We could make it more of a game;" and • "Make it more fun."

[1] No responses from 21 participants.
[2] No responses from 30 participants.
[3] No responses from 396 participants.
[4] No responses from 40 participants.

Resources

Center for Applied Special Technology (CAST)

http://www.cast.org/

CAST is a nonprofit organization that works to expand learning opportunities for all individuals, especially those with disabilities, through the research and development of innovative, technology-based educational resources and strategies.

The National Consortium on Universal Design for Learning

http://www.cast.org/pd/consortium/index.html

In 1999, researchers at CAST (see above) developed the National Consortium on Universal Design for Learning (NCUDL), a national partnership of educators, schools, and experts committed to improving access to the general education curriculum for all students, including students with disabilities. The NCUDL demonstrates best practices and effective models in consortium schools and disseminates these practices.

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National Center on Secondary Education and Transition
Institute on Community Integration (UCEDD), University of Minnesota, 6 Pattee Hall, 150 Pillsbury Dr. SE, Minneapolis, MN 55455

Tel: 612.624.2097; Fax: 612.624.9344;
Web: http://www.ncset.org;
E-mail: ncset@umn.edu

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IDEAs that Work
U.S. Office of Special Education Programs

The College of Education & Human Development
University of Minnesota

National Center on Secondary Education and Transition
6 Pattee Hall
150 Pillsbury Dr. SE
Minneapolis, MN 55455

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BOOK REVIEW

David H. Rose, Anne Meyer, Teaching Every Student in the Digital Age: Universal Design for Learning

Association for Supervision and Curriculum Development, 1703 N. Beauregard St., Alexandria, VA 22311-1714, Product no. 101042, $22.95 ASCD members, $26.95 nonmembers, ISBN-0-87120-599-8

Stephanie L. Moore

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A brief history/some background

In the 1950s, the idea of "universal design" first emerged. At the time it was articulated as barrier-free design, an idea growing in concept in Europe, Japan and the US. It is best described in the early stages as a growing global awareness of the necessity for and benefits of building environments that were obstacle-free. The early emphasis was on removing obstacles for people with physical disabilities—when a building was designed for "universal" access, it would *by design* accommodate users with disabilities. By the 1970s, the idea had matured and gained political strength. During the '70s, US architect Michael Bednar described universal design as an awareness that everyone's functional capacity is enhanced when environmental barriers are removed. The best example to date remains the curb cut—a city planning feature designed to benefit individuals in wheelchairs, but that turned out to benefit many others such as joggers, parents pushing strollers, etc. That awareness would soon become a cornerstone for design practices in fields such as architecture, civil engineering, and human factors engineering. The political strength especially came from the disability rights movement, focusing on the rights of individuals with disabilities.

By the 1980s, this concept had gained strength in numbers (or critical mass; Rogers 1995). In 1987, the World Design Congress passed a resolution stating that designers should factor disability and aging into designs, adding professional strength to the approach (Adaptive Environments 2006). A number of professions adopted universal design as a core tenet of professional practice: when a supermarket or a building or a city infrastructure or an airplane is designed and built, it should be able to accommodate a wide range of users. This "wide range" was not simply a range of physical abilities, but a range of ages and life stages—what is called "lifespan design." Any person, regardless of age or

S. L. Moore (✉)
Center for the Enhancement of Teaching & Learning, University of Northern Colorado, Greeley, CO, USA
e-mail: Stephanie.Moore@unco.edu

physical limitations or stage of life would be able to access physical environments (Mace et al. 1991). In 1987, Ron Mace coined the term “universal design” to try to differentiate from accessible design. He said, “it’s not a new science, a style, or unique in any way. It requires only an awareness of need and market and a commonsense approach to making everything we design and produce usable by everyone to the greatest extent possible.”

By the 1990s, ADA was signed into law, adding legal strength. The legal impetus drove widespread change (or at least widespread compliance). Today, companies, producers, service providers, etc., are required to be Section 508 compliant (added in 1998 to the Rehabilitation Act). Education has been somewhat behind the curve in this area—hence the book under review here.

The fundamental premise of UDL

In their text, *Teaching Every Student in the Digital Age*, Rose and Meyer put forth the most comprehensive articulation of universal design for learning (UDL) that has been offered to date. Indeed, there are many valuable aspects to the book. They state, “...barriers to learning are not, in fact, inherent in the capacities of learners, but instead arise in learners’ interactions with inflexible educational materials and methods” (p. vi). This is akin to Rummler’s statement that when you pit a good performer against a bad system, the system will win every time (2004). At the heart of UDL is the view that “failure to learn” is not a measure of the inherent capacity of the learner but a reflection of learning systems (some part of the systems, such as materials, strategies, policies or infrastructure) that fail to address the needs of all learners.

Rose and Meyer argue that brain research reveals just how different learners are and how the same instructional approaches will not work for every learner, regardless of whether a learner has a disability or not. They describe recognition networks, strategic networks, and affective networks, including what the implications of these networks are for how learning should be designed. For example, they describe how both bottom-up and top-down processing play a role in learning content often associated with recognition networks (e.g. learning to read) and how instruction that incorporates both directions of processing benefits a wider range of learners and is more responsive to diversity in the learner population. For instance, reading research reflected in the work of Adams (1990) demonstrates that learning to read becomes constrained at some point if a student only has mastered large patterns (e.g. word recognition or large vocabulary) or only has basic skills (e.g. letter recognition or letter-sound correspondence). A student with vocabulary but lack of decoding skills when she encounters new words will not develop into a strong reader. Conversely, the student who has learned to decode phonemes and words will not become a reader until he has developed a larger vocabulary and gained exposure to more contexts for understanding. Other students may have neither large vocabulary exposure in their background (a strong correlate for students who do not go on to read; Hart and Risley 1995) nor the basic skills for decoding even simple words. Given the reality of this diversity, instructional strategies that include both bottom-up and top-down processing capture a much broader range of students and the backgrounds they bring to learning environments.

Additionally, Rose and Meyer argue that UDL is now possible because new technologies make it possible to build learning materials and environments that are more flexible. They provide a positive picture for the role technology can play in creating learning systems that bend with the individuals in the systems. In his testimony before Congress, Rose adds that technology can not only help us overcome existing learning barriers but also design learning environments with fewer barriers right from the start (Rose 2001).

The authors provide an excellent treatment of setting clear learning goals and objectives, outlining just how separating outcomes from process is necessary for building flexible learning environments. For example, a universally designed learning goal will focus on end results, or outcomes, and not pre-specify means for reaching those outcomes. If the goal is for a student to learn to read beginning phonemes with criteria set (e.g. 95% accuracy), then the means for accomplishing that goal are left open. Some students will require only a few minutes of instruction and some reinforcement activities. Other students may require numerous repetitions. Still other students may respond better to a computer game or practice session that allows them high repetition in a multi-modal format.

Additionally, assessments can be designed along these same lines to allow more students the opportunity to demonstrate mastery, comprehension or application. For example, in a college level class, students can demonstrate their learning and application of course content in a final project that can take the shape of a paper, a revised unit or lesson, a multimedia demonstration, or a final product in which they apply the course content and describe their decisions based on course content.

At the core of this framework for design is an emphasis on multi-modal representations of content and flexible learning materials and systems that clearly separate ends from means. However, there are some significant gaps and assumptions in the text. These gaps may not be due to any lack of awareness of the part of the authors, however, so much as the instructional design community's lack of awareness on this topic and subsequent absence in the dialogue. Universal Design is not a new set of ideas that is yet another fad to pass, but instead has become the design standard for other professions and an adopted set of principles for Fortune 500 companies and international government agencies (see for example Japan, Pacific Bell, and UN post-conflict redevelopment policies, referenced below). As it becomes more widespread, there are some areas where the instructional design community can provide good insight that will yield strong solutions.

For example, in Chapter 3, Rose and Meyer argue that new digital media (versus traditional media of textbooks and lecture) facilitates a more universally designed environment because the new media is inherently flexible. They outline four characteristics of digital media that are particularly beneficial for classroom application: digital media are versatile, are transformable, can be marked, and can be networked. Indeed, these are potentially valuable characteristics of learning environments or materials mediated by technology. However, these are not intrinsic characteristics of the technology, in many cases. Therefore, an assumption that use of HTML (that can be marked up and linked) makes that learning resource (such as a website) flexible and accessible is an erroneous assumption. Conscious design considerations and features have to be built into the website. A website can be just as inaccessible as a building with no ramps or elevators. The technology alone is not flexible or accessible—we build those sorts of environments only through deliberate design that includes universal design and accessibility as part of the framework.

Enter the discipline of instructional design. Design models demonstrate (in different ways) that design of learning environments, materials, and systems is a conscious set of decisions centered around a variety of factors (e.g. learning goals and objectives, learners characteristics, media characteristics, message design, etc.; e.g. Morrison et al. 2004; Smith and Ragan 2005). These models can inform the universal design framework to provide a more robust framework for how flexible, universal learning systems are designed. The models highlight design considerations and provide systematic processes that, to date, are not present in the UDL literature. Additionally, the field provides a more rounded conception of technology in which inherent characteristics are separated from design decisions. What Rose and Meyer relate as the characteristics of digital media are characteristics seated in a context of decisions and individual designers who are either aware or unaware how to leverage those characteristics to achieve flexibility. The instructional design community is uniquely equipped to explore the design considerations that would yield flexible learning infrastructures and materials.

Additionally, the human performance technology literature has much to offer universal design. Nearly all of the literature on UDL, this book included, focuses solely on learning materials, strategies, and sometimes environments (classrooms or buildings). None focuses on systemic-level barriers to performance that would have to change for learning environments to become truly universally designed. From policies to rewards and incentives, to feedback systems and resources such as technical infrastructures, all these systems-level features play a significant role in whether a school or business or government entity will achieve a universally-designed environment. Without attention to these aspects of systems, Universal Design simply will not accomplish what it otherwise can. Universal Design principles applied at these levels could relieve much of the stress at the classroom and individual levels in schools and organizations. Indeed, if we pit a good *idea* against a bad system, the system will still win every time.

And universal design is not without its benefit to instructional design and performance improvement. Universal design gets at the core of learner characteristics in the instructional design and HPT models. Every model available to us today includes some sort of analysis of the learner population. Starting with a diverse definition of the learner set (or audience) in the assessment and analysis phases of the instructional design process should lead one to designs that incorporate features of greater flexibility, multiple modalities, and an understanding of how different learners access learning so that we build truly optimal instructional and performance support systems. In some ways, it is part of our professional responsibilities to ensure that the learning systems, materials, and environments we build do not limit *by design*. A book such as this can raise our awareness of our practices and elevate professional standards, even as we give back to this topic to strengthen how it is practiced.

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UNIVERSAL DESIGN FOR LEARNING PROCEDURES
IN SPECIAL EDUCATION TEACHER EDUCATION

Rebecca Elder Hinshaw

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Doctoral Committee

Gretchen Butera, Ph.D.

Genevieve Manset-Williamson, Ph.D.

Thomas Brush, Ph.D.

David Flinders, Ph.D.

September 6, 2007

DEDICATION

I dedicate this to my loving parents, who taught me to do my best and leave the rest in the hands of Jesus. Their faith, love, prayers and encouragement sustained me.

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And last but not least, my son Craig is one of my strongest supporters. He has taught me that if you sow good seeds, you will reap a good harvest. His optimism and hard-working spirit are contagious. I am blessed by the love of all of my children and grandchildren. Their support and understanding has made this all possible.

ABSTRACT

Rebecca Elder Hinshaw

UNIVERSAL DESIGN FOR LEARNING PRINICIPLES IN SPECIAL EDUCATION TEACHER EDUCATION

The purpose of this qualitative case study was to illuminate the experiences of five LLTs as they participate in a re-designed Master's practicum for special education. The practicum addressed the teacher education program essential elements of inquiry, collaboration and reflection by employing Universal Design for Learning (UDL) concepts. The case study design utilized interviews and observations of the five LLT participants, the harvesting of the LLTs' practicum products and using inductive data analysis to uncover three emerging themes. Analysis indicated that most of the LLTs used reflection as a way to connect and jointly construct and process an understanding of the UDL concepts. The UDL projects and co-teaching mandate provided the LLTs with a chance to conduct action research and using UDL, meet the needs of their diverse students in the general education classroom. Two of the five LLTs had positive changes in their teaching as a result of the practicum and UDL, while the other three LLTs reported limited changes in their teaching as a result of the practicum and UDL.

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Chapter 1

Introduction

Background

The efficacy of teacher education programs (TEPs) has been the focus of debate in recent years. Often held responsible for inadequate teacher and student performance, coursework in TEPs has been described as excessive, broken, and burdensome, by the Department of Education (U.S. Department of Education, 2002a). However, proponents for TEPs argue against these accusations with studies that suggest a positive relationship between TEP certified teachers and higher student test scores (Darling-Hammond, 2000; Lacsko-Kerr & Berliner, 2002). For example, a study by Lacsko-Kerr and Berliner (2002) noted that students taught by TEP certified teachers out-performed students taught by non-TEP certified teachers on standardized tests in language arts and reading.

Of equal concern for TEPs, particularly special education TEPs, are the changing dynamics of our nation's schools. These dynamics include: the varied educational experiences of limited license teachers (LLTs) who are working as special educators (Billingsley, 2004; Brownell, Hirsch, & Seo, 2004), the increase and diversity of students with disabilities being included in general education classrooms (U.S. Department of Education, 2002b), and the equity, accountability and research-to-practice expectations of the Individuals with Disabilities Educational Improvement Act of 2004 (IDEA, 2004) and the No Child Left Behind Act (NCLB, 2001). Of issue for special education TEPs is designing coursework that addresses these changing dynamics and provide future special

educators with experiences that allow them to transition what they have learned into practice (Billingsley, 2004).

Due to the continuing shortages of qualified special education teachers, our nation's schools are seeing an influx of LLTs working as special educators. Studies indicate that special education teacher shortages have been reported in ninety-eight percent of our schools (Boe, Cook, Bobbit, & Terhanian, 1998; ERIC, 2001), with school districts in rural areas reporting eighty percent (Knapczyk, Chapman, Rodes, & Chung, 2001). Research by McLeskey, Tyler & Flippin (2004) indicates that throughout the span of the 1990's, over 30,000 special education vacancies were filled by LLTs. This increase in LLTs has impacted special education TEPs. Many states require LLTs to pursue higher education coursework in special education as a condition of employment and licensing. Thus, Master's programs for special educators are seeing an increase in students from varied undergraduate backgrounds, taking classes to fulfill accreditation obligations (Knapczyk, et al., 2001). The diverse background knowledge and skills exemplified by LLTs create a unique learning and teaching environment for special education TEPs. The challenge for special education TEPs is to create coursework that recognizes the concerns and needs associated with LLTs.

It is well documented that the number of students being identified and receiving special education services in the general education classroom continues to grow, with recent data indicating that nearly six million students with disabilities spend a portion of their school day in inclusive settings (U.S. Dept. of Education, 2002b). Reports by the Study of Personnel Needs in Special Education (SPeNSE, 2000) indicate that an average general education classroom may contain three to four students identified as having a

disability. Further, with the implementation of NCLB (2001), all students are required to have access to the general education curriculum and be assessed using general education standards. The concern of meeting the needs of these increasing and diverse learners in the general education classroom is paramount. In response, special education TEPs must provide future special educators with coursework that allows them to meet the needs of students with disabilities in the general education classroom. Additionally, due to the inclusive setting that many special educators experience, it is important that special education TEPs prepare future special educators to work in collaborative roles.

Balancing legislative mandates with effective teacher education programming is a daunting task for special education TEPs. With the re-authorization of IDEA (2004) and its alliance with the equity, accountability and research-to-practice expectations of NCLB (2001), greater emphasis is put on special education TEPs to provide future and present educators with the training necessary to be in compliance with these government mandates, as they meet local needs for more special education teachers (Apple, 2001; Karger, 2004). For special education TEPs, the issue becomes not only providing future special educators with access to research, but also the opportunity to help bridge the gap between research and practice through their own research opportunities (Gersten & Smith-Johnson, 2001; Greenwood & Abbott, 2001).

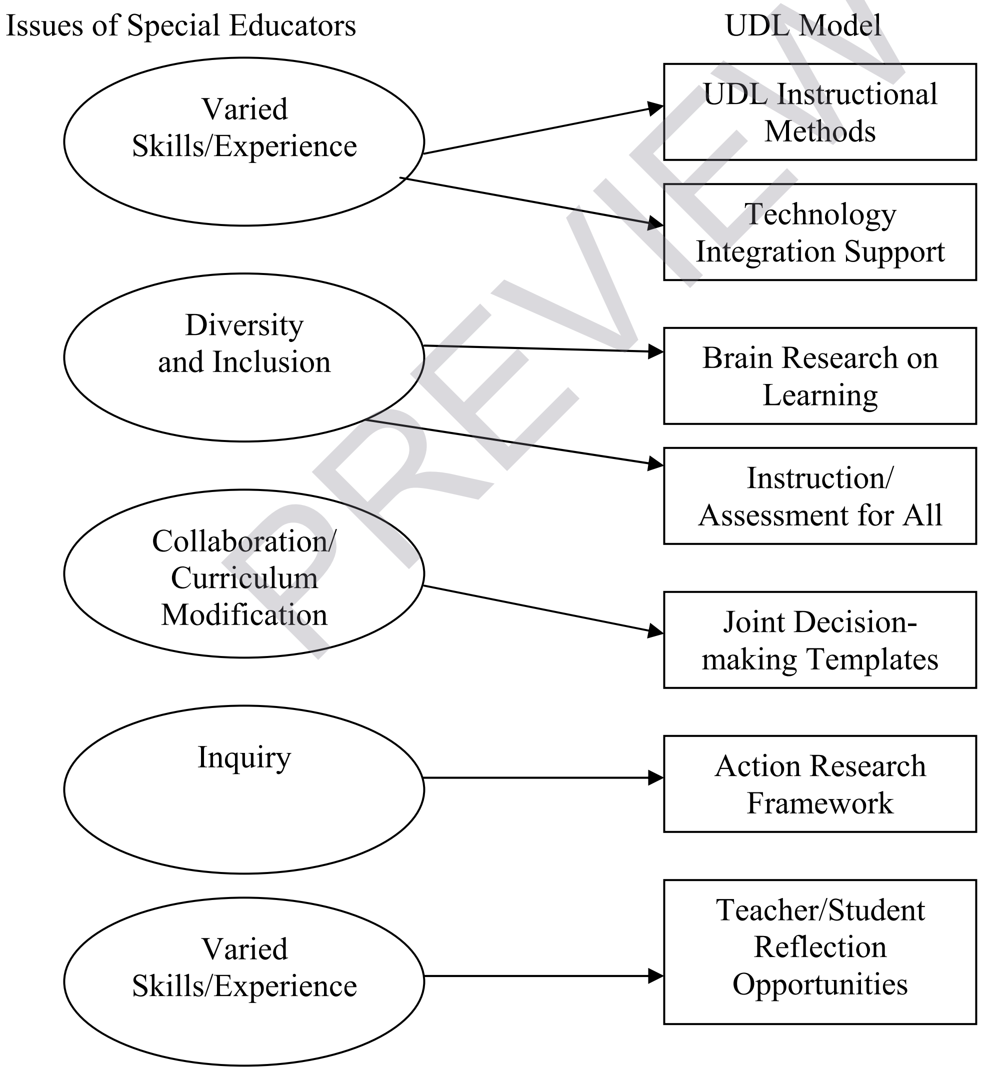
In response to these challenges, many TEPs have re-evaluated their programs (Barab, Barnett, & Squire, 2002; Lovingfoss, Molly, Harris, & Graham, 2001). To aid in this effort, teacher education reform rhetoric highlights reports and recommendations for best practices in teacher education. For example, Valli and Rennert-Ariev (2002) reviewed seven university reports and concluded that while performance based

assessment was an essential element of many quality programs, equally significant were reflection opportunities, field-based pedagogy and inquiry and collaboration experiences. Additional studies (Darling-Hammond, et al., 2000; Wideen, Mayer-Smith, & Moon, 1998) support the Valli and Rennert-Ariev (2002) findings and stress the importance of optimal field experiences supported by active faculty supervisors. Further studies that focus on the needs of special educators (Brownell, Ross, Colon, & McCallum, 2005; Fisher, Frey, & Thousand, 2003), indicate that special educators benefit from training in co-teaching and working collaboratively with general educators, adapting curriculum, and providing necessary supports to promote learning for students with disabilities in inclusive classrooms. The necessity for collaboration and co-teaching support is a common theme that is reflective of the complex and inclusive placements that special educators experience.

A promising approach to addressing the needs of special educators and students with disabilities in the general education classroom is Universal Design for Learning (UDL) (Jackson, Harper, & Jackson, 2001). The Center for Applied Special Technology (CAST) (http://www.cast.org) notes that, "UDL provides a blueprint for creating flexible goals, methods, materials, and assessments that accommodate learner differences." In designing their UDL model, CAST used information on brain processing and their own brain research. From this, they deducted that while each brain processes information in a unique manner, there are three specific areas or networks of the brain associated with learning. Their UDL model provides educators with ways to support students in each of these identified brain networks and also promotes the use of technology as a key component for teaching and learning in diverse classroom environments. The UDL

model aligns with NCLB (2001) and IDEA (2004) by promoting the use of ongoing assessment and usage of scientifically researched strategies to support students. IDEA mandates that universal design be used as an intervention to assist students with disabilities in participating more fully in the general education curriculum. Figure 1 represents how the UDL model addresses the described TEP issues of special educators in inclusive settings.

Figure 1.



Staff development programs in UDL have been implemented across the nation (CAST; http://www.cast.org) and in Indiana, 36 schools have received training in UDL through the Promoting Achievement through Technology and Instruction for All Students project (http://www.patinsproject.com). However, introducing UDL into a practicum in special education is a new idea.

Statement of the Problem

In order to redesign special education TEPs and address the urgent necessity for well-trained special educators to meet the needs of an increasingly diverse set of students with disabilities, it is important to examine how special educators translate what they learn to practice. Rich, descriptive data that portrays the experiences of the prospective special educators is needed. In an executive summary report on teacher education for the American Educational Research Association, Cochran-Smith & Zeichner (2005) point out the need for this type of case study research to shed light on " … what teacher education students learn from the opportunities they are provided within their programs" (p.30). Given the frequency with which LLTs are employed in special education, it may be especially important to understand how LLTs interpret what they learn in graduate coursework and translate it to practice.

The focus of this study was on the experiences of LLTs enrolled in a re-designed Master's practicum for special education at Indiana University, Bloomington (IUB). Through the practicum, the LLTs learned how to apply UDL in a co-teaching environment, including supporting diverse learners and using methods of inquiry and reflection.

Purpose of the Study

The purpose of the study was to illuminate the experiences of LLTs as they participated in a re-designed Master's practicum for special education that incorporated the UDL model. The practicum employed UDL concepts to address the TEPs essential elements of reflection, collaboration and inquiry.

Research Questions

1. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about reflection?
2. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about teaching diverse students?
3. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about collaboration?
4. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about methods of inquiry?
5. Among LLTs, what perceived opportunity does a re-designed special education practicum that incorporates UDL provide for learning about technology?

Significance of the Study

This study provides special education TEPs with insight into the experiences of LLTs as they participate in a practicum that uses the UDL model to support reflection, collaboration and inquiry. Since LLTs who are enrolled in Master's programs in special education have varied undergraduate backgrounds, skills, and teaching assignments, a portrait of the LLTs experiences as they participate in an IUB re-designed practicum in special education may prove valuable to understanding how learning is transferred to practice, particularly with TEP students with a variety of previous experiences.

For researchers interested in ways to bridge the gap between research and practice, the findings from this study provides information about the use of action research and the integration of UDL in a graduate course for special educators. A key element of UDL is the use of technology and this study provides information about how LLTs use technology to support their teaching. And finally, this study adds to the literature on developing the infrastructure in schools to meet the needs of students with disabilities in the general education classroom.

Chapter 2

Literature Review

Introduction

This chapter reviews literature pertinent to the questions posed in chapter one. It is divided into five sections. The focus of section one is on the role that reflection holds in teacher education, including online learning. Section two discusses co-teaching and students with disabilities and the UDL model. Section three summarizes studies on collaboration. Section four reviews the literature on inquiry and research. Section five examines technology usage in teaching.

Reflection

The ability to construct self-meaning from learning and teaching experiences is considered to be valuable to students in TEPs. Cochran-Smith & Lytle (1999) suggest that TEP coursework that promotes the analysis of everyday experiences and allows students to share those experiences within a supportive community of learners can be instrumental in establishing these reflective practices in future teaching. Putnam and Borko (2000) agree with Cochran-Smith and Lytle (1999) and through their study of adult learners, suggest that reflection should transcend self and also take into account the learners' physical and social environments-to help derive meaning of experiences. Brownell, Adams, Sindelar, Waldron and Vanhover (2006) revealed that quality teachers reflect on their teaching practice and make adjustments as necessary.

Beyond learning skills, TEP coursework that stress reflection may assist students in implementing innovative transformative practices. In a study by Lane, Lacefield-Parachini and Isken (2003), student teachers and their collaborative teachers were

instructed to reflect weekly on their classroom experiences and share their journals with one another. Through this supported interaction, the student teachers were able to instigate change in the way their collaborative teachers grouped and instructed students.

In addition, teachers and their students may benefit from the teachers' participation in shared reflection opportunities. Shank (2006) relates that teachers were able to discuss procedures, teaching techniques, and adaptation ideas when provided with opportunities for weekly reflection on their classroom practices.

Reflection is not limited to face-to-face courses and as more TEP courses are offered online, it is importance to provide students with an outlet to reflect on their experiences. For example, research by Meyers (2006) indicates that weekly online reflective journaling provided students participating in a field-based practicum, with an opportunity for self-evaluation and on-going feedback from their supervising instructor. Additionally, a study by Cook-Sather (2005) involving weekly e-mail contact between participants in an undergraduate TEP course, relates that the participants benefited from the consistent communication, space to exchange ideas and reflect on the course expectations and they also reported gaining an understanding of their classmates' lives and experiences through the online contact.

Co-teaching and UDL

An ever- increasing diverse population of students with disabilities receive services in general education classrooms, with co-teaching being the described method of special education service delivery. In one of the first article on co-teaching, Cook and Friend (1995) present five ways that co-teaching can occur in general education classrooms. In it, the authors describe various degrees of teacher-student interactions.

The co-teachers can share the responsibility of teaching the whole class instruction or one co-teacher can teach the majority of the class while the other provides alternative instruction to a smaller group of students. Both co-teachers can present identical instruction to each half of the classroom or students can move between learning stations and receive small group instruction from each co-teacher. And finally, one of the teachers can present the lesson while the other acts as a support. The authors suggest that the co-teaching model of teacher-student interaction should change in response to the needs of the students.

As co-teaching increases in inclusive classrooms, the benefits for students with disabilities continue to be an issue. The research on the advantages of co-teaching for students with disabilities has revealed mixed results. A recent example of this is a meta-analysis on co-teaching research conducted by Murawski, Weichel and Swanson (2001). Using quantitative methodology and effect size as an indicator of success, the authors discovered that only six of 89 co-teaching articles reviewed contained enough information to calculate effect size and when analyzed, the research revealed a range of effects. The highest effects were found in studies that contained dependent measures in language arts, with math measures having moderate effects and social aspects having lower effects. The authors believe that the variability is the result of the limited way in which the articles describe the actions of the co-teachers; yet, also suggest that additional research is needed to determine the effects of co-teaching on student achievement. A study conducted by Weiss (2004) notes the limited availability of research on effects of co-teaching on the skill acquisition of students with disabilities and also attributes this to an inadequate description of research methods. And while a study conducted by

Magiera and Zigmond (2005) agrees that there is inconsistent evidence for the benefits of co-teaching on skill acquisition of students with disabilities, the authors' research revealed that students with disabilities in eleven middle school co-teaching settings received a greater number of one-on-one teacher interactions as compared with similar students in teaching settings that included only a general educator.

While quantitative data on the effect of co-teaching is scarce and provides limited information, recent studies using qualitative research methods provide some insight into the co-teaching environment. For example, a study conducted by Jenkins, Antil, Wayne, and Vadasy (2003) used interview and observation data to examine co-teaching in 21 general education classrooms. The teachers in the study reported positive benefits for their students with disabilities. These benefits included an increase in self-esteem, access to an inclusive learning environment and the opportunity to participate and be successful in classroom activities. Another study by Mastropieri, Scruggs, Graetz, Norland, Gardizie and McDuffie (2005) had similar results concerning students with disabilities and provided examples of differentiated instructional supports for students in the general education classroom. Specifically, in one of the authors' case studies of a high school chemistry class, the co-teachers used peer tutoring and small group activities for lab work, rather than the general educator using whole class instruction with the special educator acting in a assisting role. The authors noted that the differentiated instruction and team-teaching model used by the co-teachers in the study provided the students with disabilities support in the general education classroom and allowed the co-teachers to interact equally with students.

Messinger-Willman, J. M., M. T. (2010). Universal Design for Learning and Assistive Technology: Leadership Considerations for Promoting Inclusive Education in Today's Secondary Schools. *NASSP Bulletin, 94*(1), 5-16.

The increased number of students with learning disabilities in general education secondary school classrooms presents complex challenges for today's educators. This article describes how the Universal Design for Learning theoretical framework can be used with assistive technology to enhance educational opportunities for secondary students with learning disabilities. Barriers that prevent secondary teachers from effectively selecting, adopting, implementing, and assessing assistive technology devices are discussed and potential solutions are identified. The article concludes with recommendations for enhancing secondary teachers' professional development opportunities. (Contains 2 tables.) (As Provided)   (1)

King-Sears, M. (2009). Universal design for learning: Technology and pedagogy. *Learning Disability Quarterly, 32*(4), 199-201.

When educators hear the term universal design for learning (UDL), most associate it with technology however, UDL is not solely about the use of technology in education. UDL is also about the pedagogy, or instructional practices, used for students with and without disabilities. Within universal design, seven guiding principles drive the design of products and environments so that they are usable by more people, to the greatest extent possible, without the need for adaptation or specialized design. When educators employ these principles in the design and delivery of instruction, accommodations noted on individualized education programs (IEPs) for students with learning disabilities (LD) may more naturally occur in general education classrooms. The educational needs of students with LD, these principles are played out in both technological and pedagogical ways. The seven guiding principles originally identified for universal design are equitable use, flexibility in use, simple and intuitive use, perceptible information, tolerance for error, low physical effort, and size and space for approach and use. However, how well students with and without disabilities comprehend from those different texts' formats is attributed to a non-technological UDL: effective pedagogy. The technology must be combined with effective pedagogy, which can either stand alone as UDL or stand with the technology. (1)

Rose, D. D., B. (2009). Learning to read in the digital age. *Mind, Brain, and Education, 3*(2), 74-83.

The digital age offers transformative opportunities for individualization of learning. First, modern imaging technologies have changed our understanding of learning and the sources and ranges of its diversity. Second, digital technologies make it possible to design learning environments that are responsive to individual differences. We draw on CAST's research and development on universal design for learning to suggest the potential of digital reading environments that are designed to support learning and engagement by addressing the diversity in learners' representation, strategic and affective networks. Optimal customization depends on continued advances in the digital tools of the neurosciences and the design and enactment of digital learning environments. (PsycINFO Database Record (c) 2010 APA, all rights reserved) (journal abstract). (1)

Zascavage, V. W., K. G. (2009). What Middle School Educators Should Know about Assistive Technology and Universal Design for Learning. *Middle School Journal, 40*(4), 46-52.

In the new millennium, the No Child Left Behind Act (2001) and the Individuals with Disabilities Education Improvement Act (IDEIA) (2004) ask educators to maximize opportunities for students with disabilities to succeed in inclusive classrooms. To make autonomy and integration seamless, many students with special needs will need to make use of assistive technology. Most middle school general educators are familiar with computer-enhanced instruction and the use of technology for research projects, presentations, and interactive learning software. As teachers restructure to meet the demand for equitable education for all students (No Child Left Behind, 2001), Universal Design for Learning becomes an important tool. Universal Design for Learning (UDL) is research-based model for curricular design that ensures participation in the general educational program of all students, including those with disabilities (Center for Applied Special Technology (CAST), 2007). This article discusses what middle school educators should know about assistive technology and UDL. (Contains 2 figures.) (ERIC) (1)

Izzo, M. V., Murray, A. & Novak, J. (2008). The Faculty Perspective on Universal Design for Learning. *Journal of Postsecondary Education and Disability, 21*(2), 60-72.

This article presents the results of two studies on the applicability and use of universal design in higher education. In Study 1, the instructional climate for students with disabilities was assessed through a survey of 271 faculty members and teaching associates (TAs) and focus groups with 92 additional faculty members and TAs. Survey respondents ranked universal design for learning (UDL) as the most needed training topic. A web-based, self-paced professional development tool called FAME (Faculty and Administrator Modules in Higher Education) was developed, piloted, and revised in response to the training needs identified. In Study 2, a review of FAME by 98 faculty members and administrators supported the value of on-demand, multi-modal professional development in universal design. Ninety-two percent of respondents reported increased comfort in meeting the instructional needs of students with disabilities as a result of using this curriculum. Implications and specific guidelines for providing educational access to students with disabilities are discussed. (As Provided) (1)

Kortering, L. J., McClannon, T. W. & Braziel, P. M. (2008). Universal Design for Learning: A Look at What Algebra and Biology Students with and without High Incidence Conditions Are Saying. *Remedial and Special Education, 29*(6), 352-363.

This article examines findings on student perceptions of individual interventions based on the principles of universal design for learning (UDL). The examination includes a comparison of the reported perceptions of mainstreamed students with high incidence disabilities (i.e., learning disabilities, behavioral disorders, or other health impairments under Section 504 of the Rehabilitation Act) to that of their general education peers. Findings showed that relative to their other academic classes, both groups of students had high levels of satisfaction and expressed similar themes as to what they perceived to be the best and worst parts of the interventions and ideas for improvement. Both groups also reported near unanimous agreement as to wanting their teachers to use more UDL interventions. The reported perceptions and subsequent comparison forms the basis for discussing the implications of UDL in high school settings. (Contains 9 tables.) (As Provided) (1)

Lieberman, L. J., Lytle, R. K. & Clarcq, J. A. (2008). Getting It Right from the Start: Employing the Universal Design for Learning Approach to Your Curriculum. *Journal of Physical Education, Recreation and Dance, 79*(2), 32-39.

The universal design for learning (UDL) approach to teaching, a method to create access for all students, can be extremely effective when adequate time, energy, and creativity are spent to apply it. The purpose of this article is to encourage the use of the universal design for learning approach to ensure the successful inclusion of all students from the beginning of the lesson to the closure. It discusses three variables that must be considered when designing a UDL lesson: (1) the attributes of the students; (2) the objectives of the lesson and individual students; and (3) modification variables. It also discusses the FAMME (functional approach to modifying movement experiences) model, a noncategorical approach (not based on disability labels) to creating modifications for lessons in order to enhance the learning of all students regardless of their ability level. This approach involves four simple steps that can be easily implemented by any teacher to create universally designed instruction: (1) determine the underlying components; (2) determine the students' capabilities; (3) match modifications to the students' needs; and (4) evaluate modifications. The article presents lesson variables that can be adapted to support various levels of underlying functional abilities. These variables, or modifications, fall into three areas: (1) equipment, (2) rules, and (3) instruction. (Contains 2 tables and 1 figure.) (ERIC)   (1)

Bernacchio, C. M., M. (2007). Universal design for learning. *Psychiatric Rehabilitation Journal, 31*(2), 167-169.

The concept of universal design (UD) emerged from architectural design of buildings that offer access for all who enter them. An innovation that was promulgated following state and federal legislation, UD is now required in all public buildings to make them fully accessible to the widest spectrum of users, including people with disabilities. The UDL framework provides guidance for creating flexible curricula and instructional environments, and for using technology to maximize success for all students, including those with physical and/or psychiatric disabilities. The UDL perspective embraces the idea of instructor creativity in developing teaching strategies and assessment techniques that are effective for all learners, while still maintaining the integrity of the course and achieving its objectives. UDL creates a learning culture in which diversity is accepted and embraced, and where all students are encouraged to learn and demonstrate their knowledge in a variety of ways. (1)

Ender, K. E., Kinney, B. J., Penrod, W. M., Bauder, D K. & Simmons, T. (2007). Achieving Systemic Change with Universal Design for Learning and Digital Content. *Assistive Technology Outcomes and Benefits, 4*(1), 115-129.

Systemic change may be achieved through a combination of the Universal Design for Learning (UDL) principles in instructional delivery, the integration of accessible digital materials, and the use of state-of-the-art technology tools. To demonstrate this premise, the Kentucky Department of Education (KDE) partnered with the University of Louisville to develop a statewide initiative that addresses the implementation of UDL. This initiative included accessibility to statewide accountability testing (CATS), digitized text system, and UDL model schools. The Kentucky Model demonstrates how systemic change can be achieved through the combination of several parts. After consideration of all factors, the authors conclude that there was an overall positive systemic change for the majority of the model schools included in the project. (Contains 1 figure and 2 tables.) (As Provided) (1)

McGuire-Schwartz, M. E. A., J. S. (2007). Transforming Universal Design for Learning in Early Childhood Teacher Education from College Classroom to Early Childhood Classroom. *Journal of Early Childhood Teacher Education, 28*(2), 127-139.

This article focuses on the application of Universal Design for Learning from theory to practice from the college classroom to the practicum experiences of preservice teacher candidates. It combines description of two research projects that explored and documented how participants understand and use Universal Design for Learning in lesson planning. Universal Design for Learning holds promise in training early childhood teacher educators to work with diverse populations and to provide access to learning for all students, including children with special needs. In Study One, 36 teacher candidates used action research to implement a Universal Design for Learning strategy, collect and analyze data, and become researchers. In Study Two, five teacher candidates were introduced to the principles of Universal Design for Learning and designed lesson plans for their practica. These qualitative research studies explored and documented how teacher candidates understand, introduce, and integrate the principles and practices of Universal Design for Learning. An overview of principles and practices of Universal Design for Learning, its use in the college classroom, its application in lesson planning and teaching, and the use of action research to determine its impact on the learning of all students in public school classrooms are presented. (As Provided) (1)

Strobel, W., Arthanat, S., Bauer, S. & Flagg, J. (2007). Universal Design for Learning: Critical Need Areas for People with Learning Disabilities. *Assistive Technology Outcomes and Benefits, 4*(1), 81-98.

The primary market research outlined in this paper was conducted by the Rehabilitation Engineering Research Center on Technology Transfer to identify critical technology needs for people with learning disabilities. Based on the research conducted, the underlying context of these technology needs is Universal Design for Learning (UDL). The paper will review demographics of the target population, the role of mainstream and assistive technologies within this context, and the emerging concept of UDL in modern education. The study investigates the educational technology industry from various expert perspectives and provides insight into its current state, unmet needs, and future course of action for the adoption of UDL in classroom settings. The intended primary outcome of this research is the facilitation of development and transfer of educational and assistive technology solutions through inclusion of data in marketing materials, business planning, and grant development. However, the benefits of the research include informed policy makers, improved pre-service teacher training, and increased knowledge and awareness of the need for UDL environments. (Contains 4 tables and 2 figures.) (As Provided) (1)

McGuire, J. M., Sally S. & Shaw, S. F. (2006). Universal Design and Its Applications in Educational Environments. *Remedial and Special Education, 27*(3), 166-175.

Universal design (UD), a concept from the field of architecture, is increasingly evident in discussions of approaches to enhance educational access for students with disabilities. Several emerging models of educational applications of UD--Universal Design for Learning, Universal Design for Instruction, and Universal Instructional Design--are discussed, with a call to the field for a collaborative approach to examine the efficacy of applications of UD to educational environments. Several critical areas for a research agenda are articulated, with caveats that the promise of UD for enhancing access not be undermined because of premature promotion of the concept before its validity is thoroughly examined. (PsycINFO Database Record (c) 2010 APA, all rights reserved) (journal abstract). (1)

Wehmeyer, M. L. (2006). Universal Design for Learning, Access to the General Education Curriculum and Students With Mild Mental Retardation. *Exceptionality, 14*(4), 225-235.

Promoting student access to the general education curriculum remains a focus of the 2004 reauthorization of the Individuals with Disabilities Education Act. This article examines educational practices that promote such access for students with mild mental retardation, overviews issues pertaining to the implementation of supplementary aids and services to achieve this outcome, introduces a planning process to assist individual educational program teams to better plan for access, and examines extant research pertaining to the degree to which students with mild mental retardation have such access. (PsycINFO Database Record (c) 2010 APA, all rights reserved) (journal abstract). (1)

Howard, K. L. (2004). Universal Design for Learning: Meeting the Needs of All Students. In the Curriculum--Multidisciplinary. *Learning and Leading with Technology, 31*(5), 26-29.

For learning to take place, the material must be challenging enough to engage students' interest, but not so challenging that they become frustrated and give up. This article discusses one teacher's challenge to figure out how to make this teaching method a reality in a classroom of 21 diverse first graders with many different learning styles, based on Lev Vygotsky's theory of the Zone of Proximal Development. This theory asserts each individual has his or her own unique learning zone and how this theory seeks to teach students in their own individual zones. The path to making this concept a reality for this teacher came in the form of Universal Design for Learning (UDL). This article touches upon: fundamentals of UDL; the teacher's first-grade classroom; UDL in practice; and how UDL addressed the issues. (ERIC) (1)

Hitchcock, C., Meyer, A., Rose, D. & Jackson, R. (2002). Providing New Access to the General Curriculum: Universal Design for Learning. *TEACHING Exceptional Children, 35*(2), 8-17.

This article examines what is meant by access, participation, and progress in the regular education curriculum and suggests a new framework for curriculum reform that holds promise for all students, particularly students with disabilities. The Universal Design for Learning (UDL) is presented and materials and methods of UDL are described. (Contains references.) (CR) (1)

O'Connell, K. (2001). Looking at Textbooks. Universal Design for Learning. Associate Editor's Column. *Journal of Special Education Technology, 16*(3), 57-58.

A study examined accommodations and adaptations for students with special needs in four teacher edition textbooks for the elementary and secondary grades. Results found that all mentioned special populations, and suggestions for students with various characteristics took the form of a page or two of general suggestions in the front matter. (CR) (1)

O'Neill, L. M. (2001). Universal Design for Learning. *Syllabus, 14*(9), 31-32.

Explains the Universal Design for Learning that provides students with multiple representations of information. Highlights include a graduate course that offered printed materials, online text, movies, videotapes, and a Web site; providing multiple representations of content for students with disabilities; and multiple options for expressing knowledge and for engaging learners. (LRW) (1)

Pisha, B. C., P. (2001). Smart from the start: The promise of universal design for learning. *Remedial and Special Education, 22*(4), 197-203.

In a few short years, Universal Design revolutionized access to public spaces with a simple message: Consider the needs of all potential users from the beginning. Universal Design for Learning (UDL) promises another revolution--this time in the development of educational curricula and materials that include potent supports for access and learning from the start, rendering them effective for a far wider range of students than traditional materials. This article traces the development of UDL from its origins in the field of architecture and CAST Inc.'s early work, and then it describes a project that developed both a model digital U.S. history textbook incorporating UDL features and publisher guidelines that facilitate the creation of digital textbooks to support the access and learning needs of the broadest possible range of users, including students with disabilities. (PsycINFO Database Record (c) 2010 APA, all rights reserved) (journal abstract). (1)

Rose, D. (2001). Universal Design for Learning. *Journal of Special Education Technology, 16*(4), 64-67.

This article presents testimony before the Senate Appropriation Committee on the future of educational technology. Assistive technologies for students with disabilities are explained, and the need for Congress to support continued development of assistive devices, digital curricula, and universal design for learning technologies is stressed. (CR) (1)

Rose, D. E. D., B. (2000). Universal Design for Learning: Associate Editor's Column. *Journal of Special Education Technology, 15*(4), 47-51.

This article discusses some of the limitations of current educational assessment and how application of universal design for learning (UDL) concepts can improve assessment accuracy and its applicability to instruction. Benefits of UDL are described and include allowing for multiple means of representation and expression, and multiple means of engagement. (CR) (1)

Rose, D. M., A. (2000). Universal Design for Learning. *Journal of Special Education Technology, 15*(1), 67-70.

This column introduces Universal Design for Learning (UDL) by explaining the concept of universal design (initial design of buildings and other products to maximize accessibility for all people), universal design applied to educational materials, the central role of learning goals in universal design, and distinctions between universal design and assistive technology. (DB)   (1)

Blamires, M. (1999). Universal design for learning: Re-establishing differentiation as part of the inclusion agenda? *Support for Learning, 14*(4), 158-163.

Discusses special education inclusion within the framework of universal design principles. Inclusion is not something that may be switched on and off, but is a process entailing physical, social, and cognitive inclusion. The Centre for Augmentative and Special Technology proposed (1998) that internet resources concerning special education inclusion curricula provide multiple representations of content, multiple options for expression and control, and multiple options for engagement and motivation. The development of inclusion policies will require understanding its parameters, preparing indices that measure effective instances of it, and creating interactive methods of fostering it. Inevitably, a universal design approach will lead to a redefinition of the term "inclusion." (1)