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A Multivariate Analysis with MANOVA-Biplot of Learning Approaches in Health Science Students

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Abstract

The acquisition of new knowledge by students represents a significant area of interest for universities, which seek to facilitate this process to enhance educational experience. There are two principal categories of learning approaches: surface and deep. The prevalence of a particular approach is contingent upon a number of individual and contextual factors. The aim of this study is to determine whether there are discernible differences in learning styles based on the geographical area of origin of the student. To this end, a multivariate analysis will be employed to compare the predominant learning approaches of health science university students using the Biggs R-SPQ-2F scale. A sample of 464 students was subjected to a multivariate analysis, specifically a Manova-Biplot, with the objective of facilitating the graphical representation of the relationships between the two learning approaches. A confirmatory factor analysis was conducted on the sample to corroborate the factor structure of the R-SPQ-2F. The findings indicated that the majority of students demonstrated proclivity towards deep learning, although their profiles exhibited heterogeneity related to their geographical context. The results may prove valuable in the characterization of the predominant learning approaches in a university community and the design of teaching strategies.



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1. Introduction

The characterization of how students acquire new knowledge is of significant value to universities, as it directly informs the development of effective teaching strategies. This understanding is frequently conceptualized within the 3P Model of Teaching and Learning (Presage, Process, Product) proposed by Biggs (1996). The Student Approaches to Learning (SAL) Theory, initially conceptualized by Marton and Säljö (1976), aimed to elucidate students' engagement with the learning process. This theoretical framework was subsequently popularized by the identification of two distinct approaches to learning. The concept of learning approaches specifically refers to variations in students' intentions, motivations, and processing strategies within a learning situation. A substantial consensus exists regarding the classification of these approaches into two distinct categories: surface and deep approaches (Biggs et al. 2001; Kember et al. 2004; Marton and Säljö 1976). It is broadly recognized that the selected learning approach exerts a substantial influence on academic performance and the attainment of desired learning outcomes.

Students who adopt a surface learning approach tend to meet the minimum study requirements (Takase and Yoshida 2021) and are motivated by a desire to complete the course (Mansfield et al. 2020). Memorization becomes a fundamental feature of this learning approach (Biggs 1988), and they carry out their tasks with minimal effort (Bunce and Bennett 2021). In addition, this type of student is prone to avoid failure (Duff and McKinstry 2007).

In essence, students who adopt a deep approach are those who are curious to seek further information in addition to that imparted in the course in order to truly comprehend and retain the subject matter (Biggs et al. 2001; Zhao and Qin 2021). These students are characterized by creativity, autonomy, intrinsic motivation, critical thinking, clarity of ideas, and good expression skills (Biggs 1988; Duff and McKinstry 2007). The teaching–learning process is most successful when the majority of students in the group adopt the deep learning approach (Dolmans et al. 2016). Also, the quality of curriculum management and teaching methods has been demonstrated to exert a significant influence on whether students adopt a deep approach to learning or whether they adopt a more surface-level approach (Entwistle et al. 2001).

Piumatti et al. (2021) found that medical and Nursing students adopt different learning approaches during their training. Those who adopt a deep-oriented approach are more likely to achieve better clinical learning outcomes than those who adopt a surface-oriented approach. Newble and Gordon (1985) observed a preference for deep approaches to learning in early medical courses. This is of significance because, at the outset of their studies, medical students are approaching their learning in a way that allows them to generate a meaningful understanding (Ward 2011).

The adoption of a particular learning approach during a student’s university career is contingent upon a confluence of factors, encompassing both individual characteristics and the prevailing academic context (Xie et al. 2022, 2023). In this context, Baeten et al. (2010) highlight that the student’s individual factors encompass a range of characteristics, including gender, age, personality, fears, previous knowledge, educational experience, epistemological beliefs, emotions, motivation, and so forth. These factors are comprehensively delineated by Biggs’ 3P Model of Teaching and Learning (Presage, Process, Product), which posits that students’ approaches to learning (Process) are influenced by pre-existing factors (Presage) and subsequently impact learning outcomes (Product) (Biggs 1996). In this vein, the individual factors—such as gender, age, personality, prior knowledge, educational experience, epistemological beliefs, emotions, and motivation—align with the student presage component of the 3P model. Conversely, contextual factors, including evaluation methodologies, teaching strategies, assessment methods, instructor qualifications, clarity of objectives, and workload, fall under the teaching context presage. Integration of these variables within the 3P Model of Biggs provides a more structured framework for interpreting their collective influence on student learning approaches.

In the field of healthcare education, the conventional teaching–learning format, characterized by didactic presentations by professors or instructors, persists (Berwick and Finkelstein 2010). However, it is important to acknowledge the emergence of alternative methods, including the Problem-Based Learning (PBL) method, which is a contextual factor favorable to deep learning approaches. Nowadays, it is widely applied in several universities in Latin America and Spain in the health field. PBL-based courses are implemented in small work groups, where the students learn collaboratively to solve a problem raised by the teacher. This method emphasizes self-learning, self-training, and cognitive autonomy, where problems are taught and learned. The student sets goals for themselves when identifying learning needs, thereby developing critical thinking that demands the competence to evaluate, intuit, debate, support, opine, decide, and discuss (Dolmans et al. 2016).

Consequently, the efficacy of learning approaches is contingent upon a number of institutional factors, including the clarity of goals and standards, the quality of teaching, the appropriateness of assessment methods, and the perceived workload (Bobe and Cooper 2020). In this context, Xie et al. (2022) propose that assessment requirements, teacher quality, student interests, and perceived peer influence have a notable effect on learning approaches. On this matter, it has been suggested that assessment requirements, quality of teachers, students' interests, and perceived peer influence were significant influences on learning approaches. According to de la Fuente et al. (2020), these factors have been consistently associated with key educational outcomes.

The findings indicate that variation in learning approaches is attributable to sociogeographical and cultural factors. To illustrate this, Zhang (2000) identified discrepancies in the learning approaches employed by individuals of varying age, gender, and parental education levels, which were found to be influenced by the cultural and geographical background of the student. Therefore, the preference for surface or deep learning approaches could be a consequence of the interaction between the individual factors of the student and the contextual and geographical factors of the teaching and learning environment.

In view of the extant literature on this topic and the paucity of studies comparing diverse geographical contexts, the principal objective of this study is to examine the predominant learning approaches of undergraduate health science students in two distinct geographical university settings, utilizing Biggs' R-SPQ-2F assessment scale. Moreover, an additional objective of our investigation is to validate the factor structure of the R-SPQ-2F.

2. Materials and Methods

2.1. Participants

The selection of institutions in Spain and Mexico was purposefully made to represent diverse higher education contexts from Europe and Latin America, respectively, while allowing for comparative analysis in key structural aspects relevant to medical and Nursing education. Although a detailed comparison of all curricular and socio-economic variables was beyond the scope of this particular study, both institutions are comprehensive universities offering similar undergraduate degrees in Medicine and Nursing, thus providing a foundational comparability in academic program structure. This strategic choice enabled an exploration of learning approaches across distinct geographic and institutional settings.

A total of 464 students were included in this study, recruited through a stratified random sampling procedure. The sampling strata were defined by university (Spanish vs. Mexican) and faculty (Medicine vs. Nursing) to ensure proportional representation across these key demographic and academic categories. Specifically, the sample comprised two distinct cohorts: 300 students from a Spanish university (34.7% enrolled in Medicine, 65.3% in Nursing) and 164 students from a Mexican university (39.1% in Medicine, 60.9% in Nursing).

Participant ages ranged from 18 to 25 years. The average age differed slightly between institutions: Mexican university students averaged 20.74 years ($SD = 1.15$), and Spanish university students averaged 19.41 years ($SD = 1.03$). Regarding gender distribution, female students constituted the majority in both university samples. Specifically, the Spanish university sample included 69.9% females and 30.1% males, while the Mexican university sample comprised 66.5% females and 33.5% males.

2.2. Instrument

The survey was divided into two sections. The initial section was designed to collect data pertaining to the selected students' sociodemographic characteristics, including age, gender, academic discipline, institution of higher education, scholarship status, and whether

they engage in concurrent employment. The second part of the survey was designed to assess the students' learning approaches. To this end, the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F) elaborated by (Biggs et al. 2001) was employed. This questionnaire was adapted to Spanish-speaking students by Hernández-Pina et al. (2005) and subsequently validated by Justicia et al. (2008). It should be noted that in this article, the various types of learning approaches will be referred to interchangeably as dimensions, factors, or scales of the questionnaire.

The R-SPQ-2F questionnaire comprises 20 items, with responses on a Likert type scale ranging from 1 to 5. The scale is as follows: 1 = 'Never or Rarely', 2 = 'Sometimes', 3 = 'Half the time', 4 = 'Frequently', and 5 = 'Always or Almost Always'. The deep learning approach dimension is evaluated by 10 of the items (labeled DA-1, DA-2, DA-5, DA-6, DA-9, DA-10, DA-13, DA-14, DA-17, and DA-18), while the surface learning approach dimension is measured by the other 10 items (labeled SA-3, SA-4, SA-7, SA-8, SA-11, SA-12, SA-15, SA-16, SA-19, and SA-20). The higher the score obtained in a dimension of the questionnaire, the more the student will be identified with the corresponding learning approach of that dimension (Hernández-Pina et al. 2010). Consequently, as a student can obtain a maximum of 50 points and a minimum of 10 points in a dimension, we define the learning approach adopted by the student in terms of a normalized learning approach score (Equation (1)).

$$\text{learning approach score} = \frac{(\text{score in deep dimension}) - (\text{score in surface dimension})}{40}, \quad (1)$$

The score ranges from -1 (indicating a student whose learning approach is perfectly identified by the questionnaire as surface) to $+1$ (indicating a student whose learning approach is perfectly identified by the questionnaire as deep). Consequently, the learning approach of students who receive a positive (or negative) score in Equation (1) is identified as deep (or surface). A review of the literature reveals that fewer than 5% of students achieve a score of 0 on the R-SPQ-2F questionnaire (González-García et al. 2019; Hernández-Pina et al. 2010). These students present a challenge for researchers attempting to identify their learning approach with certainty.

2.3. Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki. The directors and professors of each faculty were duly informed about this study and were requested to provide access for the randomly selected students to participate in this research. All students participated in the study on a voluntary basis.

2.4. Data Analysis

Firstly, a descriptive analysis of both the sociodemographic variables and the two dimensions of the R-SPQ-2F was conducted. To assess the reliability of the results obtained from the R-SPQ-2F, the internal consistency of the scales was examined through the calculation of the Cronbach's alpha coefficient.

Secondly, a confirmatory factor analysis (CFA) was conducted to test the dimensionality of the R-SPQ-2F scales and verify the fit of the model, using the maximum likelihood estimation method. The quality of CFA was verified through several fit indexes: the ratio of chi-square to degrees of freedom, which should be less than 3 to be acceptable (González-García et al. 2019); the Goodness of Fit Index (GFI), which should be close to 1; the Root Mean Square Error of Approximation (RMSEA), which should be less than 0.08; and the Standardized Root Mean Square Residual (SRMR), which should be close to 0.08 (Hu and Bentler 1999).

Finally, to visualize the relationships between the two learning approaches and compare the results between the two universities and faculties, the Manova-Biplot multivariate analysis was carried out (Gabriel 1972). The aforementioned analysis is therefore of particular interest in that it examines the faculties as a collective entity, rather than treating its students as individual units.

The interpretation of the results was significantly enriched through the utilization of a biplot, a fundamental two-dimensional graphical representation. This type of plot is particularly useful in multivariate analysis because it provides a simultaneous visual representation of groups and variables. The MANOVA-Biplot is distinguished from conventional biplots that are based on principal component analysis (PCA) in that it is derived from canonical discriminant analysis. It is specifically focused on differences between group means as opposed to the overall data variance. This technique has the effect of effectively co-localizing the group means (depicted as points) and the dependent variables (represented as vectors) within a unified spatial framework. In this graphical representation, the spatial proximity between points serves as an indicator of the multivariate similarity among group profiles. This phenomenon is indicative of the underlying homogeneity or heterogeneity in their respective dependent variable constellations. Concurrently, the length of each vector is proportional to its discriminant power, while its direction illustrates the intercorrelations between variables. Furthermore, an orthogonal projection of a group point onto a variable vector facilitates the inference of that group's relative position concerning the specific variable. For instance, if a group is projected closer to a vector representing a specific item from the questionnaire, it can be interpreted as indicative of a higher average score on that item compared to other groups. In this study, the MANOVA-Biplot was constructed from group mean vectors across the 20 R-SPQ-2F items, allowing the visualization of the canonical discriminant functions. This comprehensive visual approach enables a concise and robust identification of the variables primarily driving the observed intergroup distinctions.

Therefore, this approach allows for the differentiation of groups with the greatest discriminatory impact. The biplot graph is presented as a dispersion diagram, which visually represents the multivariate mean values of various student groups. Specifically, the ellipses that are employed to delineate each group centroid represent multivariate confidence regions (e.g., 95%), thereby enabling an assessment of the spatial precision and potential overlap between groups. This feature facilitates the evaluation of each group's dispersion and the reliability of its spatial location within the designated area. Finally, the vectors emanating from the origin correspond to the distinct dependent variables, which represent specific items from the questionnaire utilized in the study (Iñigo et al. 2004). The angles between vectors also provide information: small angles between two vectors indicate a strong positive correlation between the corresponding items, while angles close to 90 degrees suggest weak or no correlation. This approach facilitates the interpretation of the relationships between questionnaire items across the sample.

The data was stored and statistically analyzed using the IBM SPSS Statistics version 25.0 software (Arbuckle 2014). The confirmatory factor analysis (CFA) was conducted using the AMOS extension of the aforementioned software. Finally, the Manova-Biplot analysis was conducted using the MultiBiplot software (Vicente-Villardón 2017).

3. Results

3.1. Descriptive Analysis

A descriptive analysis of the sociodemographic part of the survey revealed that 99% of the selected students at the Spanish university devote their time exclusively to studying. This percentage was lower at the Mexican university, since 18.3% of the students in the sample were working in parallel to their studies. A descriptive analysis of the scores

obtained in each dimension of the R-SPQ-2F questionnaire, broken down by faculty and university, revealed the following: the average scores ranged from 21.95, SD = 5.71 (surface learning approach in Nursing at a Mexican university) to 37.74, SD = 5.48, (deep learning approach in Medicine at a Mexican university). In the case of a Spanish university, the average scores ranged from 22.21, SD = 5.76 (surface learning approach in Medicine at a Spanish university) to 30.47, SD = 5.85 (deep learning approach in Medicine at a Spanish university). The average score is higher at the Mexican university than at the Spanish university for all learning approaches and faculties, with the exception of the surface learning approach in Nursing, where the median score at the Spanish university was 23.07, SD = 6.31. Statistically significant differences (p -value < 0.01) were found between the two learning approaches in the four faculties. As can be seen in Table 1 below, the aforementioned observations are borne out by the data.

Table 1. Descriptive analysis of the scores obtained in R-SPQ-2F by the selected students. SD means standard deviation.

Learning Approach		Mexican University		Spanish University	
		Mean ±SD	p -Value	Mean ±SD	p -Value
Medicine	Deep approach	37.74 ±5.48	0.000	30.47 ±5.85	0.000
	Surface approach	23.31 ±7.09		22.21 ±5.76	
Nursing	Deep approach	36.22 ±5.08	0.000	30.87 ±5.70	0.001
	Surface approach	21.95 ±5.71		23.07 ±6.31	

Table 2 summarizes the percentages of students who adopted each learning approach, per faculty and university. The majority of students at the Mexican university opted for the deep one (92.19% in Nursing and 91.00% in Medicine); the same situation occurs for most students at the Spanish university (76.53% in Nursing and 80.77% in Medicine). Surface learning approach is present at the Spanish university in 19.39% of its Nursing students and 14.42% of its Medicine students; at the Mexican university, the presence of this approach reduces to 3.13% in Nursing and 5.00% in Medicine. A small percentage of students (less than 5% in all faculties) obtained a null normalized score, and hence their learning approach could not be identified by the R-SPQ-2F questionnaire.

Table 2. Percentage of students having adopted each learning approach, per faculty, and university.

	Mexican University		Spanish University	
	Nursing	Medicine	Nursing	Medicine
Deep learning approach	92.19%	91.00%	76.53%	80.77%
Surface learning approach	3.13%	5.00%	19.39%	14.42%
Unidentified learning approach	4.69%	4.00%	4.08%	4.81%

3.2. Internal Consistency and Confirmatory Factor Analysis

To corroborate the factor structure of the data collected from the questionnaire, the internal consistency of the scales was examined through the use of Cronbach’s alpha coefficient. The results demonstrated a high degree of consistency with an optimal fit for both universities. In the sample of the Spanish university, an alpha value of $\alpha = 0.74$

was obtained for each learning approach. In contrast, in the sample of the Mexican university, we obtained alpha values of $\alpha = 0.76$ for the deep approach and $\alpha = 0.81$ for the surface approach.

The confirmatory factor analysis (CFA) also yielded satisfactory fit indexes for the data gathered from the R-SPQ-2F. For the Spanish university, the achieved indicators were as follows: a ratio of chi-square to degrees of freedom of 2.65, GFI = 0.87, RMSEA = 0.07, and SRMR = 0.07. For the Mexican university, the values were as follows: a ratio of chi-square to degrees of freedom of 1.98, GFI = 0.85, RMSEA = 0.07, and SRMR = 0.08. It was thus observed that the model met the criteria required for a good level of adjustment to the observed data.

3.3. Multivariate Analysis

The multivariate technique known as the Manova-Biplot was employed for the analysis of different factors of planes. As illustrated in Figure 1, the initial factor plane, the 1–2 factor plane, already absorbed 94.62% of the inertia (73.08% + 21.54%). Figure 2 illustrates the outcomes of the Manova-Biplot multivariate analysis in the factor plane 2–3, which absorbed 26.91% of the inertia (21.54% + 5.38%). In this graphical representation, the sets of students belonging to each of the four faculties are represented by points. The two faculties of the Spanish university are indicated in maroon, and the two faculties of the Mexican university are represented in blue. Each of the twenty items of the R-SPQ-2F is represented by a vector, with the color of the vector indicating the type of learning approach to which the item refers. Green vectors represent items associated with a deep learning approach, whereas red vectors represent items associated with a surface learning approach. The magnitude of each vector is indicative of the variability of the corresponding item, and thus the information it contributes to the study. The angle between two vectors is a measure of the correlation between them, and the smaller the angle between two vectors, the greater the correlation between them.

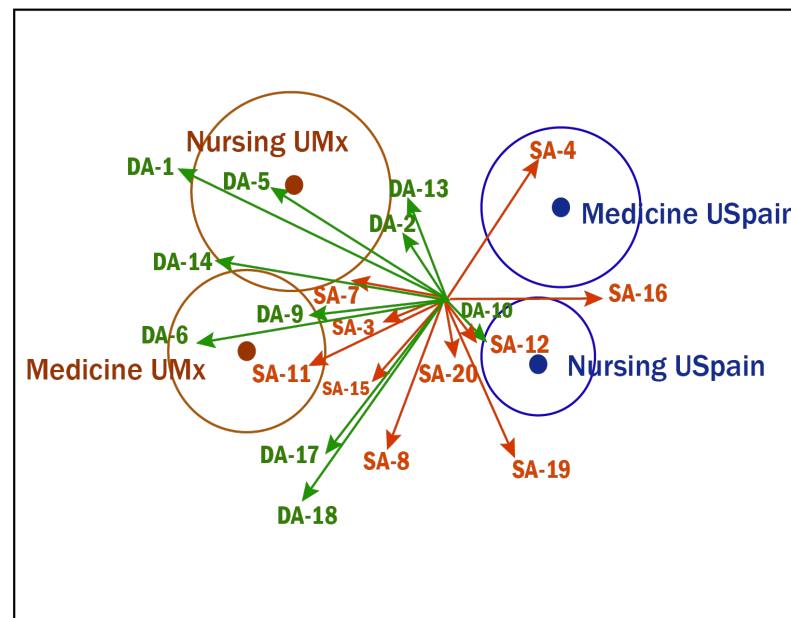


Figure 1. MANOVA-Biplot representation (principal factor plane 1–2) of the learning approaches as a function of faculty and university (Mexican university: blue; Spanish university: maroon). Each vector refers to the twenty items studied from R-SPQ-2F: surface approach (SA, red vectors) and deep approach (DA, green vectors).

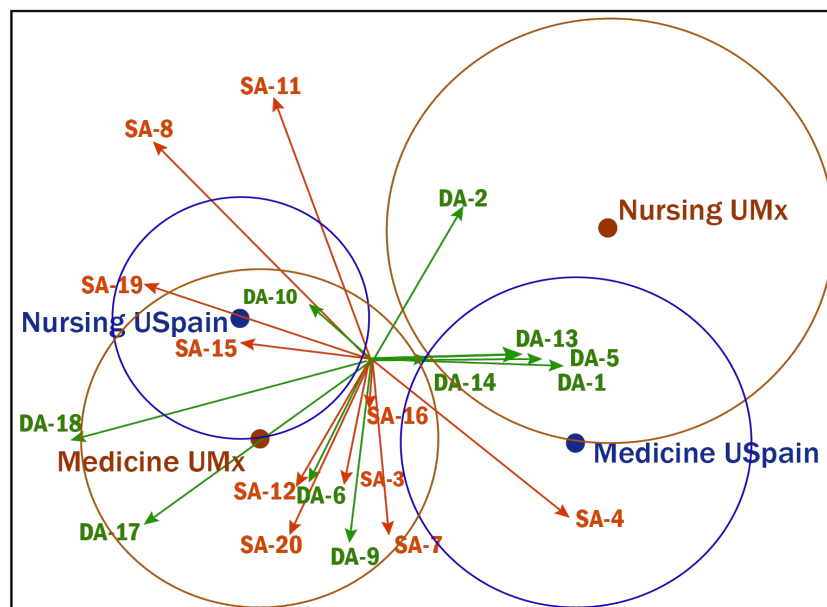


Figure 2. MANOVA-Biplot representation in plane 2–3 of the learning approaches as a function of faculty and university (Mexican university: blue; Spanish university: maroon). Each vector refers to the twenty items studied from R-SPQ-2F: surface approach (SA, red vectors) and deep approach (DA, green vectors).

As illustrated in Table 2, both universities predominantly adopt a deep learning approach. Furthermore, Figures 1 and 2 demonstrate the existence of discrepancies between the two universities. Consequently, students at the Mexican university demonstrate proclivity towards the deep learning approach, with all items pertaining to this approach deemed pertinent, with the exception of DA-17: “I come to most classes with questions in mind that I want answering” in the Faculty of Nursing, as shown in Figure 2. It is noteworthy that items DA-1: “I find that at times studying gives me a feeling of deep personal satisfaction” and DA-13: “I work hard at my studies because I find the material interesting” merit particular scrutiny in both faculties. With respect to the latter item, no Nursing student at the Mexican university provided a response of less than 3. It can thus be concluded that no item related to the surface learning approach is significant in the context of the Nursing faculty at this university.

The correlation between the Medicine faculty at the Mexican university and the SA-8 and SA-11 items is relatively low. The SA-8 item states, “I learn some things by rote, going over and over them until I know them by heart even if I do not understand them” and the SA-11 item states, “I find I can get by in most assessments by memorizing key sections rather than trying to understand them”. Conversely, the inclination towards a deep learning approach is less pronounced in both faculties of the Spanish university compared to that observed at the Mexican university. Within both faculties of this university, the following items pertaining to the deep learning approach are of particular note: DA-13: “I work hard at my studies because I find the material interesting”; DA-2: “I find that I have to do enough work on a topic so that I can form my own conclusions before I am satisfied”; and DA-10: “I test myself on important topics until I understand them completely”. The surface learning approach item SA-4, “I only study seriously what’s given out in class or in the course outlines”, is somewhat more prevalent in these faculties, particularly in Medicine. Similarly, SA-16, “I believe that lecturers shouldn’t expect students to spend significant amounts of time studying material everyone knows won’t be examined”, also exhibits a limited correlation with the faculty. In conclusion, the four faculties of this study exhibit a strong correlation with item DA-13: “I work hard at my studies because I find

the material interesting”, with a median and mean value of 4. The observed outcomes in this domain may be associated with constructs related to motivation or pedagogical methodologies. Therefore, it is essential to acknowledge the pivotal role of motivation in facilitating effective learning strategies, particularly in the context of educational materials. Consequently, the pedagogical approach can foster a proactive stance toward learning, encouraging learners to engage in both creation and acquisition of knowledge.

In Figure 2, the results of the Manova-Biplot multivariate analysis are represented in the factor plane 2–3, whose absorption of inertia is only 26.91% (21.54% + 5.38%).

4. Discussion

This study employed the R-SPQ-2F questionnaire to ascertain the learning approaches of Medicine and Nursing students at a Spanish university and a Mexican university. The primary objective was to examine the predominant learning approaches of undergraduate health science students in two distinct geographical university settings. Furthermore, an additional objective of this investigation was to validate the factor structure of the R-SPQ-2F.

The confirmatory factor analysis (CFA) also yielded satisfactory fit indices for the data gathered from the R-SPQ-2F. It was thus demonstrated that the model exhibited an adequate level of adjustment to the observed data, thereby meeting the requisite criteria. Accordingly, as posited by [Hernández et al. \(2019\)](#), the scale exhibits internal consistency and a two-factor structure, thereby demonstrating practical utility in the context of higher education in the field of the health sciences.

The aforementioned actions were undertaken with the objective of enabling a comparison between the two universities in different geographical contexts. There is a dearth of literature that compares learning approaches between two universities with a specialization in the health sciences. Moreover, no study has employed the use of a MANOVA-Biplot, also referred to as a Biplot of Canonical Variables, to analyze these differences. This is an innovative method that permits the graphical representation of the aforementioned differences.

Various studies based on descriptive analysis have emphasized that students in the health field are characterized by a deep learning approach ([García et al. 2019](#); [LoGiudice et al. 2023](#)). In descriptive terms, our results agree with these references since we concluded that the dominant learning approach in the four faculties is the deep one. Nevertheless, when delving deeper through a multivariate analysis, significant differences between the two universities arise regarding the average profile of deep students. This is an unprecedented contribution to the field, as the majority of existing studies focus on the predominant approach, without examining the nuances that differentiate the two universities in terms of the average profile of students who adopt a deep approach.

In effect, the faculties at the Mexican university are correlated with all the items related to the deep learning approach, but the faculties at the Spanish university exhibit only a sufficiently strong correlation with a few of them.

The observed differences in the average profile of deep students between the two universities may be attributed to a combination of individual, contextual, and geographical factors. However, determining which factors are the most relevant is highly complicated, and the actual influence of some factors is controversial. For instance, some authors argue that there is no conclusive evidence that individual factors, such as gender, age, intelligence quotient, and previous knowledge, and contextual factors, such as the type of evaluation, determine the type of learning approach that is adopted by the group of students. In contrast, with regard to the age of the students as an individual factor, [García et al. \(2019\)](#) indicate that students in the health field who are in their early third decade tend to adopt a deep learning approach, while [Hernández-Pina et al. \(2002\)](#) also highlight that older students are more likely to utilize the deep learning approach. In contrast to the findings

presented by [Xie and Zhang \(2015\)](#), our data yielded statistically significant evidence indicating that the learning approach adopted by students is not influenced by sociodemographic variables, including age, gender, and scholarship status, although their profiles exhibited heterogeneity related to their geographical context. Additionally, our findings indicate that the individual factor of concurrently pursuing employment and academic studies does not significantly influence the learning approach. However, the sample size of students engaged in such dual pursuits was insufficient to allow for a definitive conclusion to be drawn. Furthermore, it was observed that the impact of combining work with study on the learning approach was inconclusive. However, the sample size of students engaged in work was insufficient to draw definitive conclusions.

Pertaining to the contextual factor of the teaching method, there are several authors who affirm that, in general, it does influence the learning approach that the students opt for ([Eley 1992](#); [Sharma 1997](#); [Tiwari et al. 2006](#)). In particular, various studies in the health field context have demonstrated that teaching method promotes the adoption of the deep learning approach by the students ([Abraham et al. 2008](#); [Gurpinar et al. 2013](#)). The deep learning approach profile of students at the Mexican university is more pronounced than at the Spanish university. It seems reasonable to posit that the teaching methodology may be a contributing factor in explaining the observed differences between the two universities. Nevertheless, while it is accurate to observe that the Mexican university utilized the traditional classroom to a lesser extent than the Spanish university, it is not possible to ascertain that this variable exerts a decisive influence in this study. In this regard, numerous authors have proposed that, in general, it does exert an influence on the learning approach that students ultimately adopt ([Sharma 1997](#); [Tiwari et al. 2006](#)). However, further investigation is required to substantiate this hypothesis.

While this study provides significant insights into learning approaches within specific university contexts, it is important to acknowledge that the sample was drawn from only two institutions. While this design enabled a focused comparative analysis across distinct educational settings, it underscores the necessity for caution when extending the direct generalizability of these findings to broader student populations in different national or international university environments. Future research endeavors would benefit from expanding the sample to encompass a more diverse range of institutional types (e.g., private universities and those with alternative curricular models) and a larger number of participants. These efforts would enhance external validity and enrich the understanding of learning approach patterns across a wider spectrum of higher education contexts.

However, as posited by [Matthews et al. \(2007\)](#), these findings underscore the notion that learning approaches can be contingent upon geographical location, with observed variations often attributable to sociogeographical factors.

5. Conclusions

It is essential to contextualize the findings and implications of this study as widely as possible. This paper concludes with an overview of potential avenues for future research. The findings of this study indicate the presence of variations in learning approaches contingent on the geographical context. Moreover, the findings demonstrate that the Manova-Biplot is an efficacious multivariate technique for identifying and comparing the dominant learning approach among groups of students. This study makes a novel contribution to the field of health studies, as it is the first to analyze the quantitative and qualitative differences between two universities in this field using this statistical technique. The findings of this study illustrate that the methodology employed to assess learning approaches in university students is aligned with the structure of the theoretical model underlying the R-SPQ-2F questionnaire. The quantitative analysis demonstrated that the

deep learning approach was the predominant method among the student populations at both universities. However, the MANOVA-Biplot revealed that the deep learning approach was more pronounced among Mexican university students than among their Spanish counterparts. The technique presented in this study could prove beneficial for university authorities in characterizing the predominant learning approaches within their university community. This would enable the design of teaching strategies that align more closely with the profile of their students, with the aim of optimizing the likelihood of success in their professional careers.

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