With regard to the information to exchange between Moodle and the Simulator, as already mentioned, we have followed two of Malone categories classification to define what to exchange and from/to what component: challenge and curiosity. The third category, fantasy, is ignored because it does not suit one of the goals of the Simulator, that is, achieve a certain level of realism. Taking this into account, the information will include:

- From Moodle to the simulator:
    - Information about the user that defines the activity: The teacher can create activities into Moodle that are linked to the simulator.
    - Specific information about the activity to carry out: The teacher can set up the activity inside Moodle, with the features desired for difficulty and level of expertise that is later shown to the student in the simulator.
- From the simulator to Moodle:
    - Information about the final grade of each step for the users. With this information the teacher can know which part of the activities are harder for the students.
    - Information about the simulation sessions: Outcomes like time employed, tools used or number of errors, and the description of those errors, so the teacher can know what are the most common problems found. An also data for measuring the effort like number of times the simulation has been executed, total time employed to complete a level, etc.

With the information obtained from the simulator, the LMS can automatically associate badges [57] to the student depending on the results. They are a way of celebrating achievement and showing progress, that is a way to show when a user completes a set of tasks or achieves a set of competences. When users pass a simulation with a grade and in an acceptable time (fixed by the expert/teacher) they will obtain a course badge. These badges are compatible with Mozilla Open Badges [58] and therefore exportable to other contexts.

Fig. 1 shows the whole process for a user session to take place. The information starts to move when the teacher logs into the university LMS by using the Single Sign On System (arrow labeled with the number 1). Once logged, the teacher creates a new activity inside a specific course so students can later have access to it, represented in the figure as the arrow labeled with the number 2. This activity contains all the information to define a new game instance inside the simulator. Such information corresponds to the configuration parameters of a simulator's game instance, and contains all the elements defined previously in Malone's challenge category: information about the user, the description of each step, the steps' scorings, the skill level requirements, etc. An example of this kind of activity could be a "cataract surgery by phacoemulsification". Inside it, one possible configuration of the activity could include 10 different scenarios for the simulator, each ranked with a difficulty level: beginner, intermediate and advanced. The configuration also includes that to complete the activity, the student must successfully complete at least two scenarios of each level with at least a performance of 50%.

Once the game configuration is ready inside the University LMS, the next step comes when a student logs into the system (arrow 3). Inside the LMS, the user should see that there are activities available to perform. By selecting one, a new instance of the simulator will be created using the data provided by the LMS. This data will be loaded into the Simulator (using both HLogic and HBOgre) and the student will just need to "play" the game (arrow 4) in order to use it. While "playing", the Simulator tracks the student's performance through the haptic feedback so such information can be later transferred into the LMS. When the student has finished the game session, the Simulator collects all the performance information (arrow 5) so it can be sent back to the LMS. This information will be transferred as both, feedback for the student and outcome for the teacher. With this, the LMS will be able to generate reports from the student's performance (arrow 6). Finally, these reports are available for the teacher (arrow 7) and for the student (arrow 8).

5. Conclusions

Gamification is nowadays a very popular trend that opens new possibilities in eLearning contexts. One of these contexts is engineering education. In engineering education it is very important to provide students and teachers with tools that help them to experiment and obtain expertise by interacting with the environment they are going to find in their future working life, that is, to practice with real environments. This is something usually expensive and that requires of the presence of the expert, which makes difficult that a students can practice as much as they would like. It is necessary to find ways to help students to carry out this kind of activities in a simple and cheap way, and also to look for ways that increase their motivation and enhance their participation. Games and simulators can do this.

In order to do so this paper has presented SHULE, a framework for building virtual reality haptic simulators with which the students can touch and interact with objects difficult to obtain and manipulate. The framework makes possible the development of different simulators that can be applied to different environments in all fields of education such as civil engineering education (to interact with infrastructure), electronic engineering education (to interact with critical devices), surgery (to interact with organs or tissues), etc.

It is very important to motivate students to use these environments so they can be enriched with expert's feedback. In order to do so, the use of the simulators can be instantiated as a game. This game will provide them information about what they are doing right or wrong, their level, allow them to compare their grades with their pairs, etc. To make this possible and to take into account the game outcomes in students' grades, it was necessary to define communication ways between the LMS and the simulators. The simulator would send to the LMS the results obtained by students. This information can be used for generating a scoreboard that would help to consider the use of the simulator as a serious game. This can be the way to obtain a better response from the students, that is, that they practice more and more hours on the haptic simulator to acquire the skills needed.

As future work it would be desirable to test the system in different fields of engineering education comparing the results obtained with the ones of traditional education.

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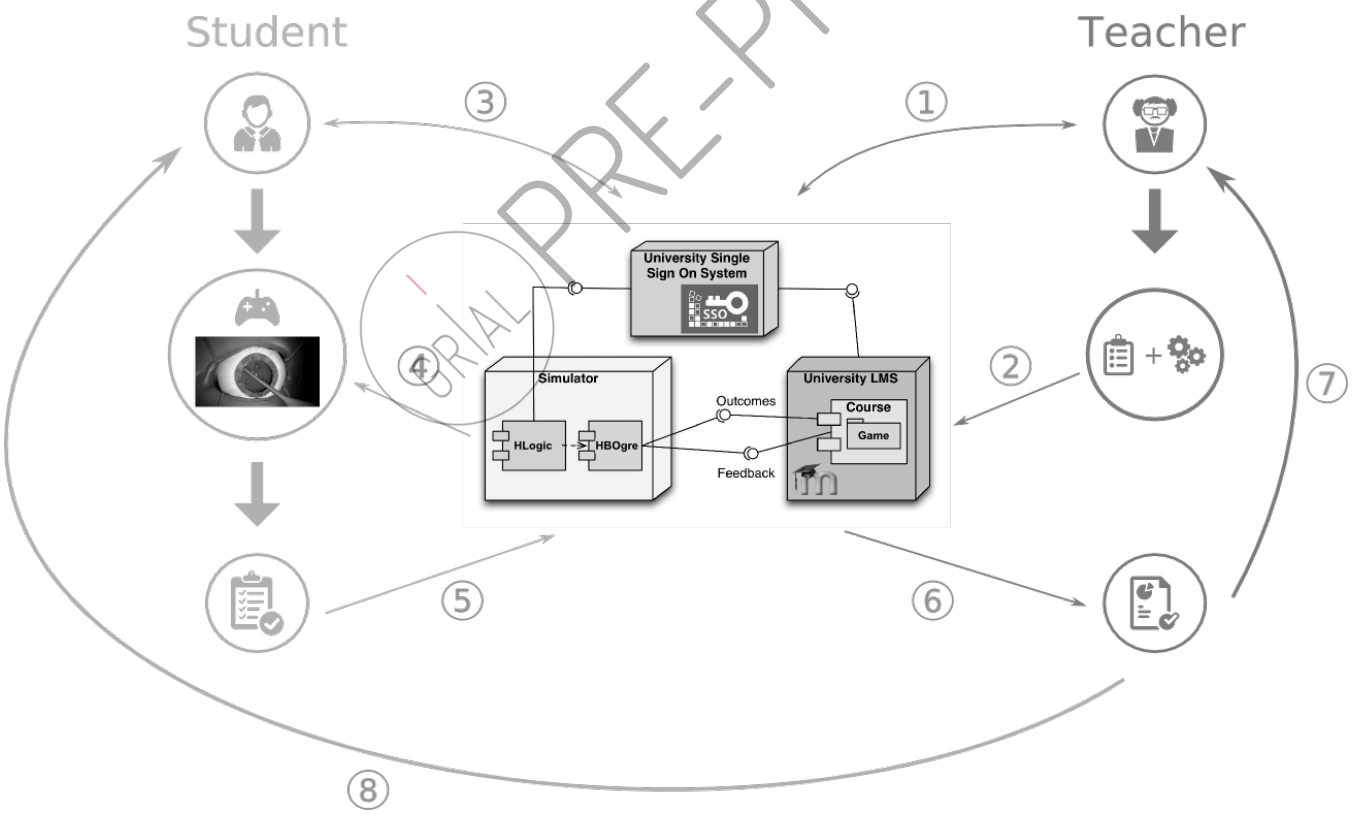

Fig. 1. Integration of SHULE and Moodle: Information flow.