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# Escape Rooms as a Way to Teach Magnitudes and Measure in Degrees in Education

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## Abstract

*In this communication we show the results of an activity proposed to students in the graduate degree in Early Childhood Education and in the graduate degree in Primary Education relative to the content unit of measurement. In this activity we simulated a situation similar to those presented in "escape rooms", in which they had to overcome a series of challenges in a limited time. These challenged were based in the magnitudes present in the Early Childhood Education and Primary Education curricula, such as length, area, volume, mass and time. These challenges involved mathematical manipulatives (such as Cuisenaire rods, hollow geometric bodies and weighting scales) to show how to use them and inspire their use in students' future teaching practice. The main objective of this activity was to show a different way of treating these contents, instead of the traditional one, which in most cases is reduced to the instrumental dimension of mathematical knowledge. In addition to this, each group had to work cohesively to be able to advance in the challenges, favoring a cooperative learning. This resulted in a greater motivation and participation by students.*

**Keywords:** *mathematics, measure, escape room, student motivation, teacher training;*

## 1. Introduction

The work we present in this paper answers to the necessity of enhancing students' motivation towards mathematics in the degrees in Early Childhood Education and Primary Education. Professors carried out an escape room experience based on contents about magnitudes and measure.

One of our objectives for this activity was to offer an experience to the students in which they had to work in a collaborative way, departing from the usual student workflow in which they split the whole task into separate parts and then join it back together, often not making any sense whatsoever.

Challenges designed involved the use of mathematical manipulatives and were focused to encourage students to get out of their comfort zone in their future teaching.

## 2. Escape rooms in education

Nicholson defines escape rooms as "live-action team-based games where players discover clues, solve puzzles, and accomplish tasks in one or more rooms in order to accomplish a specific goal (usually escaping from the room) in a limited amount of time" [2]. Success in solving these challenges is achieved by a cohesive group with communicative and organisational skills, in which members thoroughly explore every nook of the room and think critically and outside the box.

In order to have a team with these capabilities, which every person could have, a heterogeneous group is desirable.

Sánchez defines educational escape room as a creative learning environment that can be designed for any level and makes use of characteristics of escape rooms in addition to the elements and objectives of education [4].

Escape rooms as iterated before, are composed of puzzles and tasks. Wiemker, Elumir & Clare [5] stablish that these puzzles "need to act in concert with one another while providing a diverse set of challenges". This characteristic enables cooperation between group members as everyone can contribute with their set of skills. Every task follows a circular pattern, or a "game loop", as they define it: first, a challenge is presented; then a solution must be found, which can be hidden in objects around the group; and finally, a reward is obtained from overcoming the task.

Wiemker, Elumir & Clare [5] also establish four questions regarding design elements to be considered in order to evaluate whether a task is adequate or not:

- Is the puzzle integrated into the storyline?
- Are the clues to the puzzle logical?
- Can the puzzle be solved using only the information within the room?
- Does the puzzle add to the atmosphere to the room?

In the educative environment, as of late, some platforms have appeared to make things easier for educators. One of these platforms is BreakoutEDU [1], which offers teachers a variety of both physical and digital resources to create escape rooms.
As for advantages of using these kinds of experiences in education, Nicholson [3] states that enables active learning and social constructivism. The time limit also provides an unexpected benefit: students need to approach contents in a completely different way as they would in a traditional one. Finally, Nicholson claims that “they are a natural match to the learning environment of the classroom and the types of activities that students already do”.
There are also drawbacks to this approach of classwork. Often, if incorrectly designed, tasks can be focused only in opening boxes, which doesn’t differ much to traditional classroom exercises. And a clear disadvantage is the additional work that this requires to the teacher.

## 3. Teaching measure and magnitudes through escape rooms

This experience was carried out in three different classes of the graduate degrees in Early Childhood Education and in Primary Education, during the topics of measure and magnitudes. In this part of the subjects, topics such as length, area, volume, time and mass were addressed.
Having a considerable number of students in each class, the classical approach of escape rooms – this is, confining them in a closed room – was not possible, so other alternatives had to be considered in order to offer a similar experience. Having a single group with the whole class was immediately discarded, due to the possibility of only a few students working through the solutions and the rest doing nothing. So smaller groups were required. Due to the lack of physical space, two approaches were contemplated: the first one involved giving the students a compressed folder with password-protected pdf files. The password of these documents were the answers to the previous challenge. The other approach used the learning management system of the university, in this case, Moodle, setting the challenges to only appear if the previous one was solved correctly, introducing the answer. These two methods facilitated the labor of the professors, who did not have to approve manually of the answers and could provide hints to any groups that were stuck.

### 3.1 Suggested activities

In this section we show a few of the challenges that were proposed to the students. The ones left out in this paper are variations of the ones below.
**Length**: One of the challenges proposed was to obtain the length of a table when shown a series of Cuisenaire rods laid upon one of its sides. In addition to test the knowledge in this topic, this activity assessed whether the students knew how to use this mathematical manipulative.

Fig. 1 Cuisenaire rods to show length

**Area**: In this task, students were asked to compute the area of a set of floor tiles located near the classroom. This evaluated if they could correctly measure these tiles with a measuring tape or ruler and the knowledge of the formulae of different polygons.
**Volume**: In this category, we proposed two activities with different perspectives. The first implied the exact calculation of the volume of an object, using the pertinent formula. In particular, the object was a cube hold by a statue near the classroom.

Fig. 2 Statue with the cube to measure

The other activity involved the use of direct comparison of volumes given four hollow geometric bodies, which had to be arranged from smallest to largest. This could be done by filling them with water in a restroom nearby.

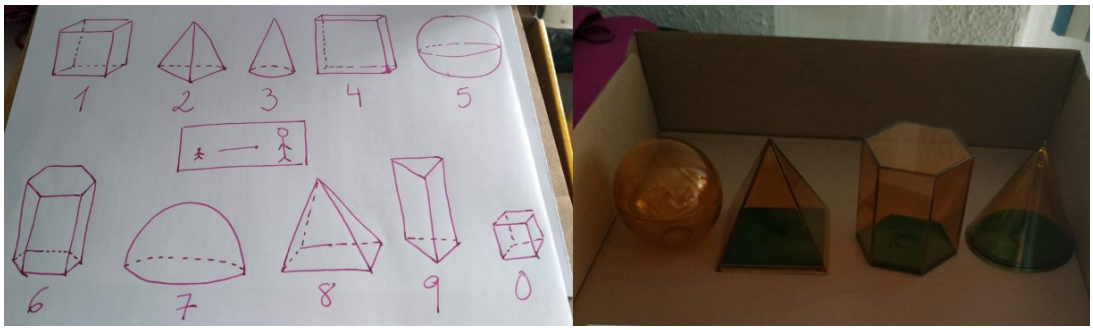


Fig. 3 Hollow geometric bodies

**Mass**: In this case, there also were two different challenges posed. The first one, was a riddle in which the students had to obtain the mass of a number of objects given the weight of several sets of them. This assessed their reasoning skills involving this magnitude. The second activity tackled a similar problem, but in a manipulative way, using a kitchen scale and bags with pebbles in them.

Fig. 4 Kitchen scale to measure bags with pebbles

**Time**: Regarding this magnitude, several problems were proposed with various wordings to test the ability of operation and reasoning with time frames.

### 3.2 Student opinions

Once the escape room was over we let the student express freely about this different experience. Immediately after finishing that class, they reflected their positive views regarding this kind of activities, as well as enhancing motivation towards mathematical problem solving. In order to obtain concrete

evidence of these opinions, students filled an anonymous survey about the activity, its strengths and weaknesses and the changes they would make.
In these reflections, we can appreciate the positive impact that Escape Room activity had in them.

- "It's a way to learn and assimilate concepts which are different to the usual ones so, in my opinion, it's more fun." (Student from Degree in Early Childhood Education)
- "I liked it a lot. The best of the subject (the rest has been good too)". (Student from Degree in Primary Education)
- "The playful environment that it creates and the stimulation to reasoning". (Student from Degree in Early Childhood Education)

In addition to the positive aspects of this activity, some of the students wanted to express in their feedbacks some of the weaknesses they had noticed:

- "It was sometimes a bit stressful because we saw other groups who were very fast and our group was slower, but at the end we finished and we had fun." (Student from Degree in Early Childhood Education)
- "Some of the test were a bit annoying because they weren't exact amounts." (Student from Degree in Early Childhood Education)

Some students would like to repeat this proposal in the rest of the subjects of the degree, while others consider that doing it more often would turn it from a success to a failure.

- "I would do more topics with this format." (Student from Degree in Early Childhood Education)
- "As a complementary activity like a review I think it's a good idea. [...] If the idea is to build the whole subject around it, replacing the theoretical classes, I think it would become a failure." (Student from Degree in Primary Education)

## 4. Conclusions

In this communication we have focused on presenting a didactic proposal about an escape room for future teachers. We have described some of its activities and the comments of the students concerning its development.
We can conclude that it has been possible to reach the main objective, which is being able to work on magnitudes and measurement in an innovative way, without reducing to the instrumental dimension of mathematical knowledge.
In addition, the development of the proposal has favored communication among students. To achieve it, we had to create a self-validating engine, favoring a cooperative learning and promoting confidence between peers. As a result, we enhanced future teachers' motivation and participation in their initial training. Students have been aware of the benefits of escape rooms as a new way to teach, which not only encourages a playful environment but also a good level of reasoning in each of the activities is estimated.
As for difficulties, most of them involved proper use of measuring instruments and precision in the different measurements.
In terms of proposals to improve this experience in the following years, as Nicholson [3] proposes, instead of students being the subjects of the escape room, we are studying the option of having them create the escape room, so as to increase engagement in the activity and assimilate better the topics discussed.

## References

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