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Gamification with active methodologies in mathematics learning in Secondary Education

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Abstract

The continuous changes that society has undergone in recent years must be reflected in the classroom, which is a challenge for the educational system nowadays. Students who have been born and who are growing up in a digital age, they are digital native, they cannot adapt to traditional methodologies as usual and they demand a methodological shift more current. Active methodologies help this change, but if used one of these active methodologies in isolation, it may not be possible to take advantage of all the strengths that they offer. This proposal aims to make explicit the advantages of combining some of these active methodologies to form a mixed methodology that can cause a change in the educational paradigm in the subject of mathematics in Secondary Education. For this, we will explain how to embed methodologies such as cooperative learning, mobile learning or flipped learning within gamification strategies. Some results are offered through the observational and experiential method. This will help the student to be the protagonist by building autonomous, meaningful and more lasting learning, in addition to promoting motivation, acquisition of some skills and teamwork.

Keywords: *Gamification, cooperative learning, flipped classroom, mobile learning, Secondary education, mathematics education*

1. Introduction

Studies carried out by different authors indicate that the implementation in Secondary Education of a curriculum based on competence development requires the use of active methodologies [1]. This type of methodologies converts students to protagonist of their own learning by developing skills of searching, selecting, analyzing and evaluating information, building knowledge and development their participation in different activities in the classroom [2].

Within these active methodologies, can be highlighted gamification that makes use of games, favoring and motivating students learning [3]. At once, this methodology can be combined with other emerging methodologies such as flipped classroom, mobile learning, challenge-based learning that, together with cooperative learning, constitute a great opportunity to redirect teaching practice towards digital native students [4]

Furthermore, regardless of the methodological approach put into practice, we cannot ignore the impact that new technologies have generated in the different educational fields, as technologies such as virtual reality and augmented reality, they cause changes to be generated in the entire teaching-learning process [5]

Therefore, the objective of the present work is to tell the methodology used in an experience with Secondary school students combining all these techniques to create a mixed methodology. For this, a brief introduction will be made in the theoretical framework and the context and how it has been carried out will be exposed, ending with some results of questionnaires answered by the students about it.

2. Theorical framework and research methodology

Educational game platforms adapted to the educational environment improve the teaching-learning process, students enjoy an immersive experience, furthermore they are very versatile and they are based on motivation [6]. These types of platforms form a good binomial with:

-Cooperative learning, where groups are made up in a heterogeneous way and consensus between components and group work is crucial to overcome the proposed challenge (challenge-based learning) [7]).

-Flipped classrooom, where the contents are studied at home through videos and practiced in the classroom by carrying out activities and dynamics [8]. If these videos are in small learning capsules (using microlearning techniques), knowledge is acquired very quickly, there is a greater retention of knowledges by the students and the results are always very good [9].

-On the other hand, in order to the gamification of learning, didactic materials must be transformed, adapting them to the forms of expression of today's digital society and basing them on the logic of

games [10]. Specifically, mobile learning presents great possibilities such as personalized, permanent and meaningful learning, available to all students; greater accessibility and usability; possibility of individual and group tasks, detection of learning difficulties and increased participation [11]
-Augmented reality and virtual reality in combination with mobile learning allows us to complete, amplify, enrich by adding layers of additional digital information and allows us to directly or indirectly visualize objects and properties that would otherwise be very difficult to learn without these tools in subjects such as geometry [12]
This proposal is part of and fits into the Design Research Paradigm that involves a series of design and analysis cycles [13]. The experimental method will be taken as a starting point for the autonomous learning of students by discovery [14]

3. Context and experience

The experience has been developed with 30 students between 14 and 16 years old from a public institute in Málaga (Spain) with a duration of approximately one month.
First of all, ICT tools were explained and usability had been overcome, to start with the gamification techniques, students registered on the Classcraft platform creating their own avatar as seen in the Figure 1

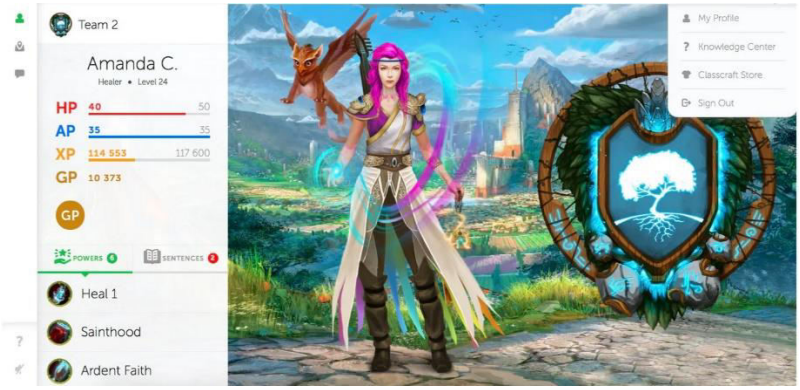

Figure 1: Example of avatar and points and powers in Classcraft. Source: Classscraft https://www.getapp.es/software/122443/classcraft

From this platform, the small microlearning video could be accessed every day with contents that would be worked on in class the next day, thus carrying out the flipped classroom methodologies. Consequently, the necessary time was left in the classroom to work in groups and with cooperative learning techniques, performing the different dynamics and assuming each member of the team their cooperative role.
Among these dynamics for learning geometry, some challenges (challenge-based learning) were proposed to work not only math but also gender, research and modeling in a transversal way. Modeling was carried out through mobile learning techniques with the social network Twitter in which some polyhedron was searched in real life by photographing them and retweeting them to the rest of the class. On the other hand, Archimedean solids were studied through augmented reality using the mobile device and later recreating through construction games. Virtual reality techniques were used to draw regular polyhedra and see and study some of their characteristics. All these activities resulted in awarding badges and points to the students at the conclusion of each one of them, with which they could improve their avatar or they contribute to the improvement of the virtual world of the team in the game platform.
In this way, as can be seen in Figure 2, all these active methodologies are embedded within the bubble of Gamification, combined with ICT tools such as augmented and virtual reality .

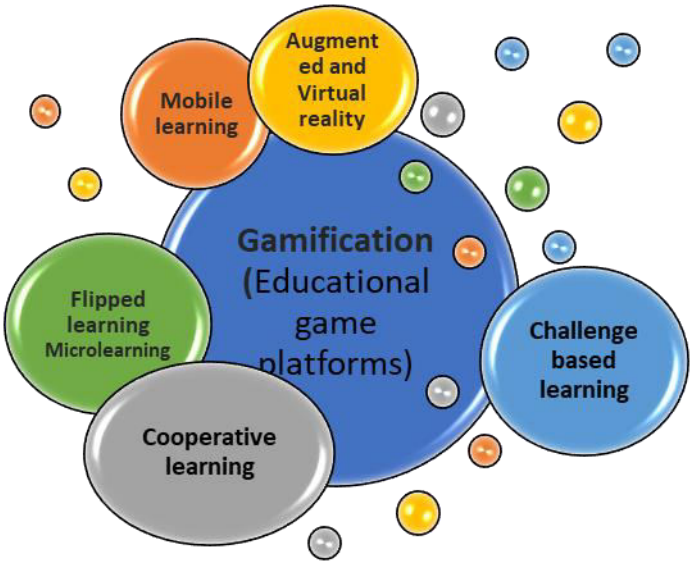

Figure 2: Scheme of the different active methodologies used in combination with ICT tools. Own source.

4. Results and conclusion

The results of a questionnaire made to the students are shown on a 4-point Likert scale, with 4 being the level with the highest acceptance and 1 the lowest, this scale has been taken so that there is no intermediate value, it is because the students could choose in one sense or another of the answer, some questions are positive and others are negative to attract attention when answering them.

As various authors have already glimpsed in relation to the students' commitment to the proposed tasks, gamification shows a greater degree of participation and monitoring of the educational actions that are proposed [15].

In Figure 3 students express their degree of satisfaction with mobile learning techniques, most of them are totally agree with benefits and utility in math applications. In Figure 4 most shows that, far from being a distracting element, the mobile device helps to learn math.

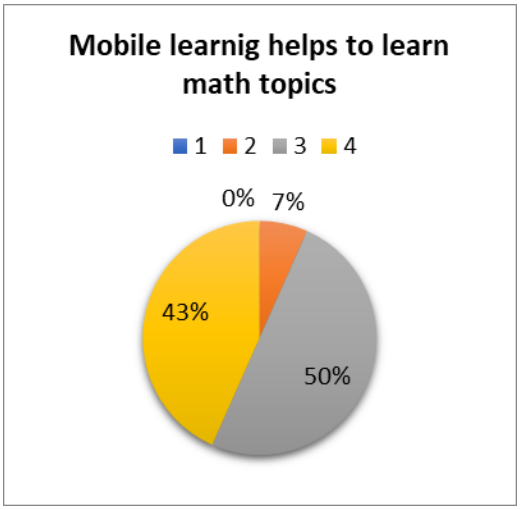

Figure 3: Students opinion about mobile learning. Own source.

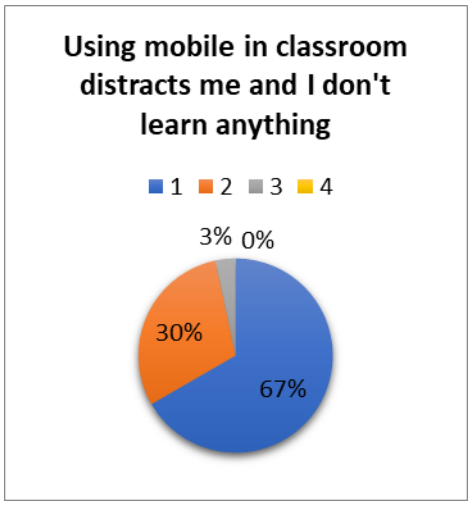

Figure 4: Students opinion about the mobile learning utility. Own source.

On the other hand, Figure 5 shows how most of students learn better with the flipped classroom videos and dynamics and in Figure 6 they are totally agree that they want to continue learning with this active mixed methodology in the rest of math topics.

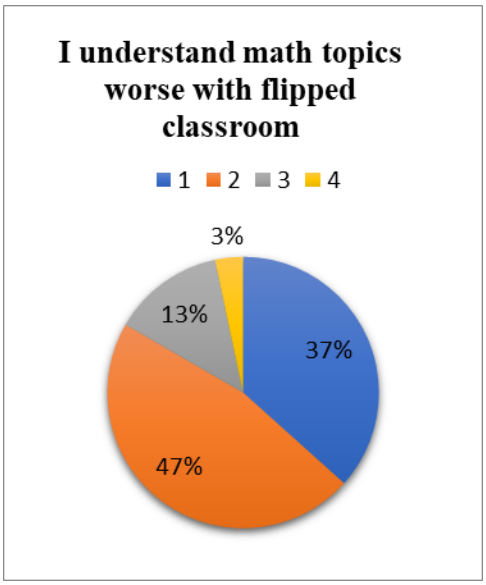

Figure 5: Students opinion on the use of Flipped classroom methodology combining with others.Own source.

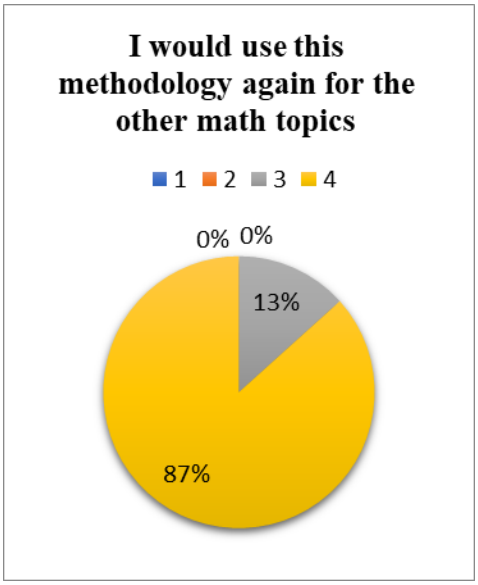

Figure 6: Students opinion use of mixed active methodology in math. Own source.

Among its advantages, the students agreed with highlighting the improvement of motivation, improvement of commitment and active participation, giving rise to experiential learning and learning outcomes [16] Thanks to the use of these technologies and mixed methodology, students are able to develop an autonomous learning [17].
In conclusion, it shows that mixed active methodology is effective and students are comfortable with it while significant learning happen throughout the experience.

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