Visual Thinking, Game-Based Learning and Digital Quiz as Strategy of Mathematics Comprehension

Silvia Natividad Moral-Sánchez[1], Rocío Roldán-Ortiz[2]

University of Málaga, Spain
University of Málaga, Spain

Abstract

Personalisation in education is key to developing learning strategies in the new educational paradigm. Placing the student at the centre of the teaching-learning process makes this personalisation possible, involving not only students, encouraging their motivation and creativity, but also teachers who can change traditional methodologies with the use of active methodologies far from teaching only purely academic content. The design of activities should be based on the students' interest, encouraging their imagination and motivation in order to make comprehensive learning possible. Given that most of the comprehension problems in the subject of mathematics are due to the lack of use or incorrect use of resources, materials or traditional methodologies by teachers, which prevent the achievement of learning, it is necessary to bring about this change. Moreover, the interdisciplinary nature of the teaching proposals with content from other subjects enriches the whole process and, thanks to ICT, they are integrated, thus enabling both to be worked on at the same time. This proposal combines ICT tools and manipulative materials based on techniques such as Visual Thinking, game-based learning and the digital Quiz, all integrated under a thematic thread that brings together the three techniques of the proposal, which will be key to the understanding of mathematical content in primary education as shown by the results obtained.

Keywords: *Mathematics, game-based learning, ICT, digital Quiz, Visual Thinking, primary education.*

1. Introduction

The traditional school understands education as a simple means of transmitting knowledge, when nowadays, digital native students demand other types of resources and methodologies and therefore, educational centres must promote other aspects, such as creativity, teamwork, autonomy, the use of ICT elements, etc [1]. In traditional methodology, students adopt a mainly passive role that prevents them from being taught this type of active competences that allow them to be the protagonists of their own learning. Therefore, it is essential for schools to immerse themselves in more innovative and active methodologies, in order to adapt to the needs of students, so that they feel involved in their own learning and can receive a quality education [2].

The use of information and communication technologies (ICT) is crucial to start from the interests of 21st century students and make meaningful learning possible [3], but we must not forget to combine them with more manipulative and playful techniques, to teach them how to use them and avoid the problems that arise due to the abuse of new technologies, thus combating dependence in the educational environment [4]. In areas such as mathematics, which requires reflection and understanding of the content covered, it is necessary to encourage reasoning and avoid the immediate information that is often provided by networks and the internet [5].

The use of methodologies such as game-based learning (GBL), Visual Thinking (VT) and the Digital Quiz are a favourable tool for achieving this objective, as they combine technological and manipulative tools [6]. Firstly, the GBL has great relevance in education, as the game is a motivating teaching technique that works the imagination without the need to use ICT, responsibility and cooperation, because in addition to the fact that it is usually played in a group, a series of rules must be known at the beginning, in order to later participate in the game and be able to win [7]. On the other hand, Visual Thinking is a tool that allows to order and organise any content to be taught, represented through images or simple drawings and short texts. In this way, Visual Thinking facilitates the understanding and assimilation of new knowledge that is difficult to assimilate, such as mathematics [8]. On the other hand, the Digital Quiz, which consists of asking a series of questions in an interactive way through the use of ICT, making it possible to increase student motivation, because at the same time as the student applies what he/she has learned in his/her answers, he/she can be evaluated in a

more entertaining way and, in addition, active student participation in the teaching-learning process is achieved [9].

2. School context and experience

The proposal was developed in a school in Malaga in Spain. The class consisted of 18 pupils in the first year of primary education. As a result of the pupils' great interest in new technologies, but also their dependence on them, a combination of manipulative and ICT-based techniques was used. In addition, the interventions were based on the theme of Trolls, an entertaining and educational series from Netflix, which the pupils loved. In this way, it was based on the interests and needs of the students. The complete proposal can be found at the following link: _Los Trolls y el mundo matemático-lingüístico_, although this communication focuses on the mathematical part, on game-based learning, Visual Thinking and the digital Quiz [10].

In the didactic proposal, we will first present the initial problem that relates the Trolls to the subject of Mathematics and the interdisciplinary subject, Spanish Language and Literature (figure 1, 2). Then, the map of the Trolls' forest, which shows the five problems that the students will have to overcome in the different interventions.

Fig.1. Introduction of the proposal.   Fig. 2. The map of the Trolls' forest

Subsequently, it will be explained to the students that in order to play the games, the class will be divided into two groups of 9 people but that the prizes will be awarded individually, depending on whether or not they comply with the rules of the game, in order to promote values such as cooperation, responsibility and empathy, and to improve relations between students. Fourthly, the first mathematical problem of the proposal will be posed, which is number 2 in the Trolls' forest (figure 3).

Fig.3. Mathematical problem.   Fig.4. Explanation of the mathematical problem.

Before playing the mathematical rally game on the mental calculation of two-digit sums, as shown in figure 4 (top right), the teacher will explain the topic using Visual Thinking methodology, supported by the digital whiteboard. And then, the students will carry out the activity using the GBL method, playing the mathematical rally (figure 5) to solve the problem of the Troll, Suki.
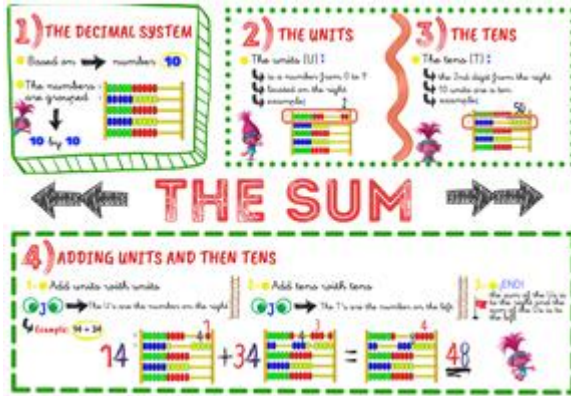
Fig. 5. Explanation - Visual Thinking.

Fig. 6. GBL Activity - Mathematical Rally.

Finally, the pupils will think they have solved all the problems in the Trolls' forest, but this is not the case, as an unexpected problem arises with the human maths specialists, who ask them to solve a digital quiz to complete all the problems (figure 7 and 8). In addition, an index card with the Quiz questions will be handed out to all the students, so that each one can reflect on the answer, while volunteers go out to answer them on the blackboard.

Fig. 7. Digital Quiz Cover

Fig. 8. Example of one digital Quiz question

3. Results

In this section, we will show the results in graphic form of a questionnaire that was administered to students, who participated in this proposal. This questionnaire is made up of 6 items on a 5-point Likert scale, the highest score being 5 and the lowest, 1.
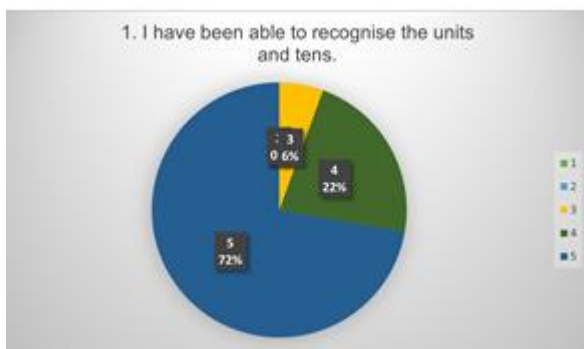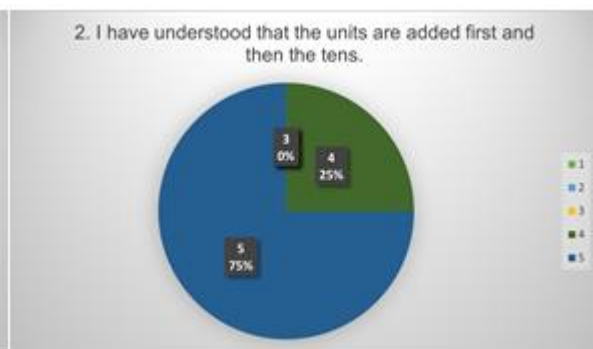

Fig. 9. Question 1 of the questionnaire

Fig. 10. Question 2 of the questionnaire

In the graph for question 1 of the questionnaire (figure 9), we can see how 72% of the students are able to recognise both the units and the tens, as this is fundamental for getting into the mental calculation of two-digit addition. In the second graph, from question 2 (figure 10), we can see that 75% of the students understand that the units are added first and then the tens.
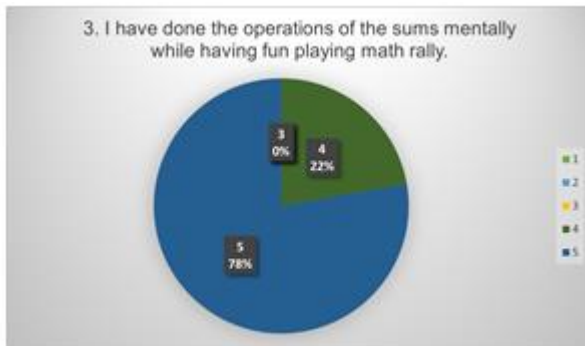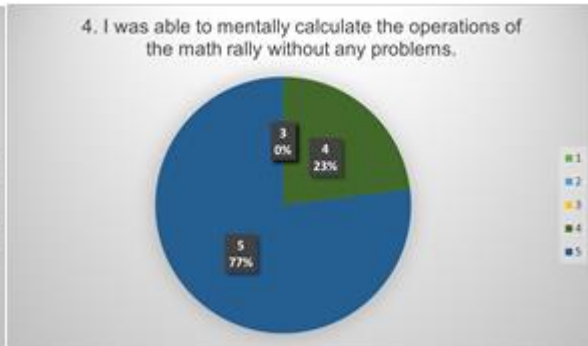
Fig. 11. Question 3 of the questionnaire

Fig. 12. Question 4 of the questionnaire

In reference to whether the pupils have carried out the sum operations mentally while having fun playing the maths rally, we find that 78% agree totally and 22% strongly agree (figure 11). On the other hand, in question 4 of the questionnaire (figure 12), 77% of pupils were able to calculate the operations of the mathematical rally mentally without any problem.

Fig. 13. Question 5 of the questionnaire

Fig. 14. Question 6 of the questionnaire

In the last two graphs, firstly, we can see that 83% of the students have completed the digital Quiz and obtained excellent results (figure 13). And finally, in question no. 6, we can see that 90% of the students think that it has been great fun to learn mathematics by playing in a team, with the Trolls theme and evaluating themselves with the digital Quiz, with the consequent encouragement of motivation throughout the process.

4. Conclusion

Based on the results obtained after the implementation of the proposal and with the support of the arguments put forward in the theoretical framework by way of introduction, it can be concluded that active methodologies in line with innovative tools make it possible for students to be the protagonist of their learning and feel motivated in the process, being able to learn mathematical knowledge while having fun, thus promoting a comprehensive education [11]. Visual Thinking as an explanatory technique in mathematics favours the understanding of new knowledge [12]. On the other hand, game-based learning keeps students interested in carrying out activities and, by playing as a group, promotes the acquisition of both purely academic aspects and others that are not, but are fundamental in the teaching of children, such as the values of responsibility, empathy, respect, etc [13]. And finally, the digital Quiz serves to evaluate students in a more interactive, formative and fair way, as the assimilation of mathematical content explained in a more critical way can be checked, without the need for a traditional exam that encourages rote learning [14].

For all these reasons, education must advocate innovative teaching methods that encourage a creative and reflective teaching-learning process in students.

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