The Teaching of Mathematics through Minecraft: The case of problem-solving via the reduction of the unit

Dimitra Longinou
30th School of Piraeus, Greece
dimitralogginou@yahoo.gr

Abstract
The teaching scenario presented in this article has been applied to the primary school at a 4th-grade level of mathematics and utilizes the intelligent environment - the world of Minecraft digital game to approach the meaning of creative problem solving via the concept of unit reduction method. At the same time, it combines innovative educational technologies with advanced learning processes, techniques, and the promotion of tools and alternative processes that take place at all levels of a modern educational system tailored to the needs and requirements of the digital age.

Keywords: Minecraft, mathematics, creativity.

1. Introduction
As a sandbox game, Minecraft embodies the principles of 21st-century learning, including creativity, challenge, problem-solving, and strategic thinking. Within a short period of time, the game succeeded in dominating the field of education and attracting the interest of several scholars. Many researchers have focused on providing ideas on how teachers can use Minecraft to teach the various subjects of the syllabus in the classroom (Gallagher, 2014), while others have focused on how teachers-through this particular game - they learn to use digital media. The present work falls into the first category and touches on the second. The approach can serve as a pool of ideas for the teachers and help them to familiarize themselves with the game environment (Dikkers, 2015).

In addition, the problem-solving method helps children to learn by working on a problematic situation. This enables then to construct their knowledge by facing the problem, while trying to resolve it. The students are expected to observe, understand, analyse, interpret find solutions, and perform applications that lead to a holistic understanding of the concept. A problem is a task for which the solving may involve the handling of the data to provoke changes (Giannoulas, 2009).

The educational approach aims to create and solve a complex problem based on the activities of daily living in the province. The children are divided into three groups. Each team has twenty minutes at Minecraft to collect as many products as possible. Inventories are used for the construction of a house. The specific educational approach analyses the concept of unit reduction by adapting the central question of lesson 44 of the textbook for the 4th-grade Maths to the Minecraft environment (Christou, 2007).

Moreover, it uses a simulated application environment for students. Students have the opportunity to explore and collect data to answer the central research question. Also, it approaches the concept of unit reduction in a holistic way and thus helps students to grasp the totality of a subject in a practical and creative way (Mikropoulos, 2000).

Finally, it develops collaboration between teachers and trainees, since the teaching is designed by the teacher, but implemented by the students, who work with both the teacher and their classmates (Matsagura, 2008).

2. Reduction in unit

To implement the educational action, it is necessary to have:

- A computer
- An installation of Minecraft
- A Projector to display the research results to the board,

where everything is validated and checked for good operation before the lesson begins (Roblyer, 2008).

The time needed to implement the educational approach is two hours, (90 minutes) and can be applied as an introduction to lesson 44 of elementary school mathematics textbook (Roblyer, 2008).

At the beginning of the lesson, students discussed what they would like to build in the game. Also, they decided on what materials they would use to complete their task. Through voting, students concluded that they would like to build a home. Through the draw, the children were divided into three groups. The coordinator asked members of the class to determine the main material needed in the game to build the house, and they referred to wood. Then she challenged them to transform the central question of lesson 44 to so that it can respond to the game. The question of the book was: "If 8 vases with quinces cost 16 euros, how much do 5 kilos of quinces cost?" The new question was: "If the 12 tree trunks give 60 planks of wood, how much do the 19 tree trunks give?" To answer the central question, students needed to cut down trees in the Minecraft. Each group had to cut six to seven trunks, depending on the number of members and then record the results in order to begin the construction of the house (Fischbein, 1987).

Figure 1. Pupils look for tree trunks

The other groups observed in the projector the effort of their classmates and planned their own movements in the game (Huttner, 2008). During the time of research, the students encountered the following issues:

- The 7th tree yielded several woods much larger than the previous trees. This did not seem normal to the team which observed the game better, and concluded that the research question had to be concluded again, as Minecraft has many types of tree sizes. Thus, they reworded the question as follows: "If the 12 middle type tree trunks give 60 planks of wood, how much do the 19 middle type tree trunks give?" (Athanasiadis, Salonikidis, & Simotas, 2009).
- While recording of the results, it was observed that some of them had slightly deviated from the dominant trend. After discussion, it was concluded that said specific case fell within the margin of statistical error (Athanasiadis, Salonikidis, & Simotas, 2009).

Table 2. Record of results

Tree trunks	Planks of wood
1st Tree trunk	5 planks of wood
2nd Tree trunk	5 planks of wood
3ed Tree trunk	5 planks of wood
4th Tree trunk	5 woods (4 planks of wood at first)
5th Tree trunk	5 planks of wood
6th Tree trunk	5 planks of wood
7th Tree trunk	5 planks of wood (25 planks of wood at first)
8th Tree trunk	5 planks of wood
9th Tree trunk	5 planks of wood
10th Tree trunk	5 planks of wood
11th Tree trunk	5 planks of wood (7 planks of wood at first)
12th Tree trunk	5 planks of wood
13th Tree trunk	5 planks of wood
14th Tree trunk	5 planks of wood (7 planks of wood at first)
15th Tree trunk	5 planks of wood
16th Tree trunk	5 planks of wood
17th Tree trunk	5 planks of wood
18th Tree trunk	5 planks of wood
19th Tree trunk	5 planks of wood

For the next twenty minutes, the teams utilized the conclusions and with the help of the moderator:

- They investigated the case and calculated the outcome of the research question. Initially, they added 12 times the number 5 and they calculated that the sum is 60 planks of wood. Then, they added 19 times the number 5 and found that the sum is 95 planks of wood (Anand & Ross, 1987).
- They comprehended that all it was needed was to multiply 5 by 12 to check if the assumption was correct, and 5 by 19 to find the solution· since multiplication is actually a small addition (Anand & Ross, 1987).
- They found out that if we know that one tree trunk yields 5 planks of wood, we can easily find the result. And they wondered if we could did use this number (the number 5) from the research question, without playing the game in advance (Kolese, 2000).
- After experimenting with the figures of the research query, children found out that if we divide the 60 by 12 we take the number 5 (reduction in unit).

At the rest of the time they applied the first case of reduction of the unit to the book's respective activities, exercises, or questions, and students enriched their knowledge (Newby, Stepich, Lehman, & Russel, 2009).

3. Conclusions

In summary, this educational approach gave students the opportunity to develop their mathematical thinking, since they were relieved from the ambiguity of large numbers. They were also able to think critically to complete the task assigned to them. In addition, the children discovered the steps needed to apply the first case of reduction to the unit. At the same time, they were able to develop their research skills, through their contact with quantitative research methods (Newby, Stepich, Lehman, & Russel, 2009).

Furthermore, the educational approach has enabled children and teachers to operate within a context which covers the modern educational needs for creativity, strategic planning, innovation, collaboration, and teamwork, while also enabling the development of the intellectual capacity of its teaching potential. Finally, through resolving of a challenging situation, they effectively integrated both foreigners and students with special educational needs into the learning process.

In particular, this educational proposal has given students with learning difficulties the opportunity to participate as equal members in the group as well as enhanced them to work harmoniously with other pupils (Belasco, 1990).

At the same time, students realized that for successful teamwork, it is necessary to allocate responsibilities according to each member's capabilities and finally combine the individual results produced (Hackman, 1990).

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