Chapter 7
Open Educational Resources for Improving the Visualization and Reasoning Cognitive Process: A Way to Learn Math

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ABSTRACT

Frequently, the process of learning mathematics is reduced to the memorization of concepts or algorithms solution. This fact does not allow mathematics to be really understood, causing a certain displeasure for learning it. This chapter aims to describe the experience of a group of students using an OER for vector learning and its applications. The apps used promote learning because students establish a direct relationship between at least two types of three proposed registers. They are numerical, geometric, and verbal. It was possible to identify two basic operations of conversion and transference between two registers, as well as an evolution in the reasoning process from the natural discursive process to the theoretical discursive process. This resource has been created, stored, and distributed under the scheme of open educational content, with the purpose of promoting open education through gamification in order to facilitate the knowledge and motivation for learning mathematics.

INTRODUCTION

Often, when learning mathematics, certain concepts are not well understood, problem-solving processes and meaningless exercises are memorized, which consequently are easily forgotten (Orozco & Morales-Morgado, 2016). Some concepts, rather than being learned significantly, were acquired through memorization as forms without content, only relations of meaningless symbols, which lack tangible meaning and application necessary for learning. However, it is possible to learn mathematics in a dynamic and effective way, if it is taught with an instructional design that allows that students interact with the environment. So, they are able to communicate and make representations and interpretations of mathematical objects

DOI: 10.4018/978-1-7998-4156-2.ch007

that lead to solving problems related to reality and situations that surround them (del Valle-Ramón, García-Valcárcel & Basilotta, 2020). Authors have created playful learning methodologies and strategies in order to combat students' lack of interest in learning mathematics during the first semesters of higher education. This fact makes the learning process towards mathematics attractive and encourages student's motivation, participation and creativity (Morales & Villa, 2019).

Soylu (2007) says that the reason students have difficulty understanding is because the concepts are difficult to articulate and require a high level of mental activity. Another aspect is that they do not see the importance of the use of the concepts in some area of their interest (Dominguez, García-Planas, & Taberna, 2015). So, they are not aware of what the concepts mathematically mean or what applications they have.

In this way, the use of semiotics representations is essential for the teaching-learning process of certain mathematical concepts. However, in an expository class some representations are not as simple to construct. They require too much time for their elaboration, or the error of the human calculation can be performed. These factors may discourage or confuse the student, leading to a lack of interest, wrong learning, or lack of learning. Mathematical Software in the classroom could help with this situation. The construction, manipulation and reconfiguration of the semiotics representations can be executed instantaneously and, consequently, an adequate visualization of the concept is being represented.

On the other hand, García-Peñalvo, García de Figuerola and Merlo-Vega (2010a) mention that the Open Knowledge works in four main areas: Free Software, educational resources or Open Contents, scientific contents or Open Science and Open Innovation. The educational resources created in this proposal comply with the principles of the Open Contens area, since they are educational contents that have been created, stored and distributed under the scheme of free and open access. It is noteworthy that they were created with eXelearning and GeoGebra, a free mathematical software. That is, all content is open and easily accessible. Based on the above, these resources can be defined as Open Educational Resources (OERs), that is to say, "any type of educational materials that are in the public domain or introduced with an open license. The nature of these open materials means that anyone can legally and freely copy, use, adapt and re-share them" (UNESCO, 2002); and "thus contribute to the activities promoted by the Open Educational Movement, which is defined as open access educational activities for training" (Ramírez-Montoya & García-Peñalvo, 2015 in Orozco & Morales- Morgado, 2017, p.40). The OERs used in higher education promote the creation, transference and extension of scientific knowledge, since the student has open access to certain information from anywhere (García-Peñalvo, García de Figuerola & Merlo-Vega, 2010b). These types of practices promote the so-called open educational movement (Ramírez-Montoya, 2015), that enables trainers to innovate in their teaching and research practices, create shared construction experimentation laboratories, collaborative academic networks, multidisciplinary projects that transcend contexts and research in order to generate open knowledge.

The use of OERs promotes open education through gamification, which shows two benefits, on the one hand, democratization and access to knowledge, and on the other, the motivation generated by virtual recreational environments for learning (Garcìa-Holgado et al, 2020). Therefore, this work proposes the use of a collection of OERs for teaching and learning definitions, types and basic operations of vectors. They were built with GeoGebra and eXelearning. The purpose of these constructions is to enhance the understanding of concepts, based on certain cognitive processes that students experience when learning geometry. The objective of this work is to identify the effects of OER's use for learning definition and graphic representation of operations with vectors.