THE UTILIZATION OF STEM METHODOLOGY AND THE NEW ROLE OF THE TEACHER

Η ΑΞΙΟΠΟΙΗΣΗ ΤΗΣ ΜΕΘΟΔΟΛΟΓΙΑΣ STEM ΚΑΙ Ο ΝΕΟΣ ΡΟΛΟΣ ΤΟΥ ΕΚΠΑΙΔΕΥΤΙΚΟΥ

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Abstract

Nowadays, technology is rapidly finding its place many areas of daily life while decisively influencing many human activities. In addition, it continues to have a significant impact in the field of education, especially in secondary education. Today, most schools in Greece are equipped with computer labs to properly train students. The purpose of this research is to highlight the importance of computer presence in the learning process taking place ether in the laboratory, or not. More specifically, this study clarifies the role of the teacher, points out methods to be used by teachers to facilitate collaboration with students, and signifies the impact of computers in the learning experience.

Key words: *technology, laboratory, computers, education, STEM.*

Περίληψη

Στις μέρες μας, η τεχνολογία διεισδύει ταχύτατα σε πολλούς τομείς της καθημερινής ζωής ενώ επηρεάζει καθοριστικά πολλές δραστηριότητες του ανθρώπου. Επιπλέον, εξακολουθεί να έχει σημαντικό αντίκτυπο και στον τομέα της εκπαίδευσης, ιδιαίτερα στη δευτεροβάθμια. Σήμερα, τα περισσότερα σχολεία στην Ελλάδα είναι εξοπλισμένα με εργαστήρια ηλεκτρονικών υπολογιστών προκειμένου να καταρτίσουν κατάλληλα τους μαθητές me τα απαραίτητα εφόδια. Σκοπός της παρούσας έρευνας είναι η προσέγγιση της διαδικασίας της μάθησης με χρήση ηλεκτρονικών υπολογιστών σε εργαστηριακά και όχι μόνο μαθήματα. Πιο συγκεκριμένα, η μελέτη αυτή αποσαφηνίζει το ρόλο του εκπαιδευτικού, επισημαίνει τις μεθόδους που χρησιμοποιούν οι εκπαιδευτικοί για την διευκόλυνση της συνεργασίας με τους μαθητές, αλλά και διευκρινίζει την επίδραση των υπολογιστών στη μαθησιακή διαδικασία.

Λέξεις Κλειδιά: *τεχνολογία, εργαστήριο, υπολογιστές, εκπαίδευση, STEM.*

1. INTRODUCTION

Schools nowadays try to provide all the necessary supplies for the education of students, but also they try to orient their future in ways that allow them to cope with the ever-changing conditions of the labor market (Bybee, 2010). In today's educational environment, the need for classrooms with the best available technological equipment is vital and for this reason, it is considered appropriate to have adequately trained teaching staff (Chamyal, 2019).

However, the integration of technology in the learning process cannot be done without challenges (Farag, 2018). The biggest challenge is to enable students to benefit from technology while maintaining classroom harmony and giving great importance to the learning outcome (Harron et. al., 2017). In a "disorganized" classroom, the teaching and learning experiences will never be effective (Jones & Jones, 2013).

Studies (Jones & Jones 2013; Inner & Burak, 2014; Waterfield & West, 2008) showed that the difficulties in teaching laboratory courses using computers include, among others, the loss of control of the room and the students' attention, as well as several difficulties that mainly concern the supervision of laboratory examinations. In contrast, well-organized classrooms provide a positive learning environment that improves student performance (Edwin et. al., 2017) and increases their confidence in the use of electronic learning media (Ian, 2010). However, most of the methods used to manage laboratory computers, in public and private schools, are outdated and cause intense pressure, stress, and anxiety to teachers and all involved parties that handle them (Countryman, 2014).

Previous studies (Edwin et. al., 2017) have shown that there is a positive correlation between working time, appropriate educational activities, and high learning achievement (Ian, 2010). Kounin (1970) defined effective classroom management as "the product of a conjunction between a high rate of participation in work and a low rate of lack of concentration and distraction."

For educational purposes, there is a plethora of software that can be used in order to organize a laboratory lesson. Recently, many studies by Edwin et. al. (2017) grouped all computer management software in one single category consisting of programs utilized by a teacher in computer labs, in order to maintain students' attention and enhance lesson delivery (Edwin et. al., 2017).

"Shared monitoring" is a feature of laboratory management software that allows the replication of the teacher's computer screen on the rest of the computers that are part of the laboratory (Edwin et. al., 2017). There are generally many types of commercial software that can be adapted for the purposes of educational institutions. This software shares some common features such as the ability to allow an instructor to lock a student's computer during class, and the ability to easily supervise and interact with their students either individually, in groups, or with the entire class (Deepak & Surendrasingh, 2013). More specifically, this process allows educators to save time by running applications and sharing files on all computers in the classroom, monitoring student activities, and improving the quality of the lesson (Deepak & Surendrasingh, 2013). Acer Classroom Manager (ACM) is an example of classroom management software developed due to the rising needs of both teachers and students to establish the necessary organizational standards within a classroom. The same software though can also have applications in other purposes, such as the mass repairment of technical issues that arise within a computer network (Edwin et. al., 2017).

2. FRAMEWORK FOR STEM

The term STEM education refers to the teaching and learning of Science, Technology, Engineering and Math subjects. More specifically, STEM is an approach that aims to introduce Technology and Engineering in the teaching process of Natural Sciences and Mathematics (Sismani, 2020). Therefore, STEM education is an innovative approach when it comes to the design of an institution's curriculum. It would also help streamline the educational content production, seeing as there are four different learning subjects that can be merged and taught into one larger module (Edwin et. al., 2017).

Dominant role within this approach have the various problem-solving techniques (Asghar et. al., 2012) and the enabled part that trainees should have in discovering the solution, in a transdisciplinary way (Edwin et. al., 2017). In other words, STEM

implementations attribute the computational experiment and the computational way of thinking, specifically in transdisciplinary levels, but also cross-curicular (Xenakis, Kalovrecis & Papastergiou, 2019; Kallianta, 2019).

Over the years, several researchers have tried to establish the necessary skills people of the 21st century should demonstrate (Kallianta, 2019). More specifically, such capabilities need to focus on (Association for Career and Technical Education, National Association of State Directors of Career Technical Education Consortium and Partnership for 21st Century Skills, 2010): a) critical thinking and problem-solving, b) cooperation and leadership, c) flexibility and adjustability, d) initiative and entrepreneurship, e) effective written and oral communication, f) data analysis and g) curiosity and imagination.

However, according to other studies, the necessary skillset that people of the 21st century should demonstrate are as follows (Windschitl, 2009; Bybee, 2010): a) adjustability, b) complex communication and social skills, c) the not so typical problem solving, d) self-management and self-development and e) systemic thought. Through ways of STEM education it is possible to develop skill needed in the 21st century (Xenakis, Kalovrecis & Papastergiou, 2019). Moreover, STEM education is considered to be a mean of help to people in order to develop different transdisciplinary problem-solving strategies and acquire skill, knowledge and abilities that will allow them to find scientific and economic recognition (Lacey & Wright, 2009).

The implementation of STEM courses in the curriculum is aimed –on an international level– to be a standard in the educational systems of various countries, given that it can considerably prepare and strengthen the students, allowing them to respond to all future labor and social needs (Means et. al., 2008; Means et. al., 2016). In fact, it appears that countries that have utilized STEM activities in their educational approach, such as South Korea, Japan, Finland, Germany, have achieved a better ranking in PISA evaluations (Marginson et. al., 2013).

3. THE NEW ROLE OF THE EDUCATOR

STEM teaching is primarily an interdisciplinary approach to learning, in which rigorous academic concepts are combined with real-world cases, while students apply science, technology, engineering, and math within a context that links school, community, and work (Tsupros, Kohler, & Hallinen, 2009). At the same time, global companies that enable the development of STEM are succeeding in being much more competitive in the new, stronger economy (McComas, 2014).

It is well known that the purpose of STEM education is twofold: a) an in-depth conceptual understanding of the concepts, based on the four STEM cognitive objects, using STEM epistemology and b) students' understanding of STEM cognitive objects across various social contexts and the labor market (Mohr-Schroeder, Cavalcanti & Blyman, 2015; Psycharis, Kalovrektis & Xenakis, 2020).

Teaching STEM as an interdisciplinary approach demands the transition from traditional educational practices to supporting students in acquiring knowledge. Consequently, STEM teachers should (Kennedy & Odell, 2014): a) implement educational practices so that students are "challenged" and dare to innovate and seek; (b) use both the problem-solving method and the project method pending specific learning outcomes; c) develop meaningful learning opportunities through a

collaborative learning environment; (d) require students to show that they understand this approach in an environment that models real-world concepts; and e) offer students cross-disciplinary and multicultural perspectives to reflect on how STEM education transcends national borders and unites students within a broader STEM community. In other words, recent research has emphasized the need for teacher training in the interdisciplinary area of STEM teaching (Doukakis, Katsoulis & Pylioti, 2016; Konsoulidis, 2019).

In Europe, the European Network of Schools (European Schoolnet), through the European Scientific Network (Scientix), plays a key role in disseminating STEM education practice (Means et. al., 2016).

4. CONCLUSIONS

The rapid rise of technology in today's world has been accompanied by the need to equip classrooms with the best educational technology. The biggest challenge for integrating such kind of technology into learning, arises from that fact that students should be allowed to benefit from learning technology, while at the same time such advancements should be ensuring that the classroom members are productive and well-managed through means of collaboration. All researchers emphasize the importance of a comprehensive, interdisciplinary STEM education that encourages students to learn about the physical world through exploration, research, and problem-solving experiences.

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