Chapter 15
The Impact of Dynamic Geometry Software on Creating Constructivist Learning Environment

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ABSTRACT

This chapter aims to review the ways that digital technologies may impact learning geometry. To be more focused, Dynamic Geometry Software (DGS) is investigated as an assistant digital in the classroom for discussing the impact of learning geometry. Particularly, it is discussed whether DGS may have an effect on some knowledge accession skills suggested by constructivists approach. The chapter indicates that DGS has positive impacts on providing a constructivist classroom learning environment. Even though there is much research indicating the positive impacts of DGS in providing an environment shaped by the constructivist approach, some research provides different results. The reasons the results contradict each other could be explained by the prior knowledge, skills, and needs of students; a lack of time for whole class discussions; and insufficiency in the design of DGS applets and worksheets. Therefore, it should be noted that using DGS alone cannot create a learning environment shaped by constructivism.

INTRODUCTION

Digital technologies play an important role in everyday life for many people, at home, in the work place, and also in schools the range of hardware and software tools and programmes such as personal computers, assistive technology scanners, digital cameras, multimedia programmes, image editing software, database and spreadsheet programmes are regarded as digital technology. In addition, internet, e-mail and video conferencing are also digital technology equipment which has the potential to help people communicate with each other (NCCA, 2004). The use of these digital technologies in education is effective: they trigger curiosity and thinking, challenge the intellectual abilities of learners (Newman,

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2000), enhance achievement (Christmann & Badgett, 2003). Mathematics is regarded one of the major educational fields by several researchers, who suggest using digital technologies, in particular computers, as a supportive tool in the classroom (Baki et al., 2000; Cheng-Yao, 2008; Freeman, 2012; Forgasz, 2006; Laato et al., 2019; Mariotti, 2002; Wiest, 2001, Zengin, 2019).

"The dynamic and symbolic nature of computer environments can provoke students to generalise and formalise and make links between their intuitive notions of mathematics and the more formal aspects of mathematical knowledge" (Godwin & Sutherland, 2004, pp. 131-132).

In the United States, the National Council of Teachers of Mathematic's (NCTM) Principles and Standards for School Mathematics provides six principles for mathematics education. One of them involves the role of digital technology, and indicates that "Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning" (NCTM, 2000, pp. 24).

One of the main integrations of digital technology into mathematics education is in the application of mathematical software for teaching purposes. Mathematical software encourages students to develop and maintain their computational skills, supports their higher order thinking skills (Kerrigan, 2002), shows advantage in promoting mathematical achievement (Cheung & Slavin, 2013; Li & Ma, 2010). In particular, the use of DGS is thought by many researchers to be a way of providing opportunities for students to develop a deeper understanding of geometrical concepts and problem solving strategies (Healy & Hoyles, 2002; Hershkowitz et al., 2002). As Er and Sağlam Kaya (2017) states, DGS makes a significant contribution to mathematics learning and teaching and it has an important place in this field.

This chapter describes ways in which the use of digital technologies may impact on learning geometry. In order to be more focused in terms of the use of digital technology, DGS is chosen as an assistant digital tool in the classroom for discussing the impact of learning geometry. Although there are points to be made about the impact digital technology has on learning geometry, such as enabling high level achievement (Chan & Leung, 2014; Çetin et al., 2015; Günhan & Açan, 2016; Vatansever, 2007; Zengin et al., 2012), motivation (Borazan, 2019), self-efficacy (Gawlick, 2002; Işıklar & Aşkar, 2005; Şeker & Erdoğan, 2017), and positive attitude (Balcı Şeker & Erdoğan, 2017; Barutçu Akyar, 2010; Eryiğit, 2010; Uzun, 2014), this chapter attempts to focus on the ways that DGS may have an effect by promoting collaborative learning through creating an interactive learning environment, providing a student-centred environment and developing higher order thinking skills in geometry. These can be regarded as the basic knowledge accession skills by constructivist approach. The chapter is divided into three parts. Firstly, it starts with a background information about constructivist approach and this is followed with a detailed explanation of DGS. After that, the chapter reviews some research using the DGS supported learning environment to discover its effects on creating a constructivist learning environment. Although DGS is a satisfactory tool in classrooms in terms of creating a constructivist learning environment, it is unlikely that the use of DGS alone can guarantee constructivist learning. Finally, it draws a conclusion in light of all the issues discussed in this chapter.

BACKGROUND

Constructivist Approach

Constructivism involves an explanation of the nature of knowledge and how human beings learn. It suggests that learners create or construct their own understandings or knowledge through the interaction