Towards Digital Competencies in Mathematics Education:
A Model of Interactive Geometry

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ABSTRACT

Technological innovation has influenced learning, and teachers have suggested different ways of use for digital equipment, to improve learning and to achieve better outcomes from their students. Today’s youth has grown up with digital technology and has lived immersed in environments populated by computers, video games, digital music players, video cameras, cell phones, and thousands of other toys and tools of the digital age. It is for this reason that the authors are persuaded that education in the 21st century should be directed to use digital resources as well as digital ways of teaching in all subjects. Mathematics needs digitization and the paper deals with the development of dynamic sketches for geometry teaching and learning. The concept of dynamic geometry is introduced and discussed together with problems and examples of application of dynamic geometry software. The model for interactive geometry visualization is described and the implementation of this model is reported. Together with former topics an experimental research is presented, which is based on the use of the interactive pre-constructed sketches by the dynamic geometry software Geometer’s Sketchpad. At last the didactical approach of the experiment is analyzed, the results of the experience are described and conclusions and discussions are proposed.

Keywords: Digital Competencies, Digital Literacy, Dynamic Geometry, Geometer’s Sketchpad, Mathematics Education

1. INTRODUCTION

We can indicate digital literacy as the set of the attitudes, understanding and skills to handle and communicate information and knowledge effectively, in a variety of media and formats. Digital literacy can be seen as the ability: (1) to use digital technology, communication tools or networks to locate, evaluate, use and create information, (2) to understand and use information in multiple formats from a wide range of sources when it is presented via computers, and (3) to perform tasks effectively in a digital environment. It includes the ability to read and interpret media, to reproduce data and images through digital manipulation, and to evaluate and apply new knowledge gained from digital environments.

It may be suggested that digital literacy is not a dichotomy, but a hierarchical concept that exists in a continuum. It is also relative, in the sense that may take different meanings in
different cultural settings and socio-economic contexts. Finally, its acquisition targets contemporary socio-economic problems and prevailing educational conditions involving notions of power, dominant ideology and hegemonic culture. These elements all emerge in a recent EU consultation report, which states: “Digital literacy should be aimed, with appropriate specificity, at different groups of the general public, taking into account the different contexts of each group (p. 59)… (and that) digital literacy is a complex and extensive process that develops through diverse procedures, in different areas and involving several actors” (Tornero, 2004, p. 65).

Nowadays content is extended digitally and technologically. In mathematics, for example, we should be focusing on “future mathematics” – approximation, statistics, binary thinking. Geometry for example should be learned by playing with it: dragging the shapes, filling the volumes, etc.

In order to summarize the debates on the key competencies, many international institutions, such as OECD, UNESCO, European Commission launched surveys and settled several recommendations. Digital literacy, media, information and communication technologies (ICT) and other modern technology-based skills are essential requirements for the 21st century learner’s education (Ananiadou & Claro, 2009). ICT competency and skills are important for every citizen in the modern society. The fact that these skills have never been the focus in traditional education is a serious problem. Delivery and acquisition of these skills in teaching and learning to the students of primary and secondary education will require a shift in what we teach, how we teach it, the tools we use and how we educate, train, nurture and retain our teachers and the school leaders. The overarching challenge for all the educators is today to rethink not only what they teach, but “how they empower students to use that information” (Murnane & Levy, 2004).

We cannot change how our students learn, unless our teachers are equipped to teach in new ways. Research shows that a teacher’s qualification has a significant effect on student’s performance, more than any other variable (Barber & Moursched, 2007). It is unrealistic to expect that our students will ever gain the skills and knowledge to succeed in the 21st century, if they are taught primarily by educators trained with educational models developed in the 19th century. It is very important to rethink and overhaul teachers’ training and professional development programs, in order to recruit and retain high achieving educators who have up-to-date knowledge of 21st century skills.

Recent studies assert that “the quality of an educational system cannot exceed the quality of its teachers’ and that “the only way to improve outcomes is to improve instruction” (Barber & Moursched, 2007).

21st century teachers should be achievers who model the behaviour they expect their students to learn. Through team projects and latest technology they will maintain the focus on the core academic skills and will use their classrooms as laboratories for the students to explore, create and work together. They could participate in professional development opportunities to keep their skills up-to-date, and collaborate with their colleagues to share the best practices.

Mathematics’ education has increasingly focused on the interactive learning methods as well. The scientific literature shows that interactive mathematics teaching goes parallel to dynamic sketches, and there are more than 50 tools for dynamic geometry all over the world. They all have the same goal – to teach geometry using the dynamic sketches while helping the students gain an insight into geometry (and sometimes algebra) concepts and proofs. Those researchers who can be considered constructionists see an important opportunity in these programs – to study geometry by constructing it (Hay & Barab, 2001). Educational and psychological research shows that learning by constructing dynamic sketches makes geometry understanding deeper, the understanding of the geometric concepts becomes more meaningful, geometric thinking and geometric imagination
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