Enhancing In-Service Primary Teachers’ Technological, Pedagogical and Content Knowledge on Mobile Mathematics Learning

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ABSTRACT

This article reports on the main insights from a study aimed at equipping a group of in-service teachers with the knowledge, skills, and practical experience required to effectively integrate tablet devices within the mathematics curriculum. A professional development program focused on mobile mathematics learning and based on the Technological Pedagogical and Content Knowledge (TPACK) framework was designed and implemented in Cyprus. Six primary school teachers participated in the program. Participants experimented with different ways in which coding apps, and other types of constructivist mobile applications could help students internalize key mathematical concepts across the primary curriculum. They also worked together to develop and/or deliver instructional interventions integrating the use of mobile devices. Findings indicate a positive impact on in-service teachers’ perceptions regarding mobile-enhanced mathematics, and on their competence in productively utilizing mobile apps as an instructional tool.

KEYWORDS

Coding Apps, Mathematics Education, Mobile Learning, Mobile Mathematics Learning, Mobile Technologies, Primary School, Tablets, TPACK

INTRODUCTION

Since the introduction of the iPad in 2010, there has been a rapid adoption of tablet devices in educational institutions worldwide. The hegemony and dominance of fixed personal computers is diminishing quickly, making way for a variety of flexible, ubiquitous alternatives that have enormous implications for learning, within both formal and informal settings (Burden et al., 2012). We are in the midst of the timeframe where tablets and smartphones are becoming standard learning tools, and adopting mobile devices in the classroom and beyond is becoming essential. Mobile mathematics learning – which studies the ways in which the mobility of learners, augmented by suitable handheld devices, can contribute to the process of gaining new scientific knowledge, skills and experiences – has become a cutting-edge research area that has lately attracted considerable attention from the mathematics education community.

Despite the increased interest in mobile devices as learning tools, the amount of available primary research studies on their integration into mathematics teaching and learning is still relatively small due to the novelty of these technologies. More research is needed to determine the best ways of utilizing...
tablet technologies in the mathematics classroom. However, the conducted studies do overwhelmingly point towards numerous positive attributes that have the potential to enhance both formal and informal learning of mathematics (Burden et al., 2012; Henderson & Yeow, 2012; Kyriakides, Meletiou-Mavrotheris & Prodromou, 2016). The existing literature highlights exciting opportunities offered by mobile devices for a transformative shift in mathematics education (e.g. Boogart, Carlson-Bancroft & Milman, 2014; Clark & Luckin, 2013; Henderson & Yeow, 2012).

The current article contributes to the emerging literature on mobile mathematics learning. It reports on the main experiences gained from a study which aimed at providing a group of in-service primary school teachers with the knowledge, skills, and confidence required to incorporate tablet technologies within the mathematics curriculum. Building on the notion of the TPACK as a conceptual framework (Mishra & Koehler, 2006), a professional development programme was designed and implemented in Cyprus. Six (6) teachers (4 males, 2 females) teaching mathematics in different grades of primary school during the 2016-2017 school year participated in the programme. The programme’s impact on the study participants was examined from three perspectives:

1. Influence on teachers’ attitudes and perceptions regarding tablet technologies and mobile-based mathematics teaching and learning
2. Impact on the development of teachers’ TPACK regarding the instructional integration of tablets
3. Level of transfer and adoption of TPACK competencies acquired through the study intervention to actual teaching practice

BACKGROUND

Mobile devices have significantly increased the range and sophistication of possible classroom activities, providing the opportunity to create entirely new, inquiry-based learning environments in mathematics. The existing literature strongly indicates their significant potential as ubiquitous tools which, when constructively used, can radically transform and enrich mathematics education by creating hands-on and engaging mathematics learning environments (Clark & Luckin, 2013; Henderson & Yeow, 2012; Melhuish & Falloon, 2010). The literature suggests that the affordances offered by tablets and other mobile devices can be used as the machinery for students to engage in authentic problem-solving activities that can help raise their intrinsic interest in mathematics, and promote the attainment of important competencies essential in modern society.

Despite the undisputed educational potential of mobile technologies, educators might face various challenges when introducing them into the mathematics classroom. One of the biggest challenges is in selecting educationally sound applications. The reach and scope of educational apps is deep and wide and often with little regulation or curation (Chau, 2014). Many of the available apps often include mediocre or even inappropriate content. Chau (2014), for example, who conducted content analysis to examine and evaluate the breadth, depth, and design quality of 100 apps from the Apple’s App Store for iPad targeting preschool children, found that only 58 percent of the apps were meaningfully designed for preschool children in terms of user interface, audio and visual design, and instructional support. He found that the current offering of children’s iOS mobile apps tends to fall into either the camp of didactic drill-and-practice or free play experiences that lack a purpose.

Although high quality, developmentally meaningful mobile apps for children are less common than hoped, some exceptional exemplars that could be utilized in the mathematics classroom to help create constructive, meaningful, and valuable mathematics learning experiences for children do exist (Chau, 2014). A promising example of good quality educational apps currently available are coding apps, which teach children the concepts behind programming in a playful context. Several educational apps are currently available for helping children with no coding background or expertise to grasp the basics of programming through the exploration and/or creation of interactive games and other applications (e.g. Hopscotch, Hopscotch Technologies 2014; Bee-Bot, TTS Group Limited 2012;
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