Editorial

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1 Introduction

With the rapid growth of mobile technology and wireless communication in this digital era, mobile and ubiquitous learning environments have been recognised as a pedagogical tool to motivate and facilitate students' learning in STEM (science, technology, engineer, mathematics) disciplines. To date, the onset of mobile and ubiquitous technology and wireless communication advancement brings with its visions that innovative learning environment can transform STEM education (Srisawasdi, 2018). Regarding to the advancement, Hwang et al. (2008) pointed out that the progress of wireless communication and sensor technologies have evolved the research and development of electronic learning (e-learning) to mobile learning (m-learning), and is, currently, evolving from m-learning to ubiquitous learning (u-learning). Today's mobile and ubiquitous learning technologies have created numerous new opportunities and challenges for the education of STEM (Srisawasdi et al., 2017). The technical progression of mobile and ubiquitous computing technology brings a plenty of chance to design and develop the innovative learning environment with mobile devices, and it also enabled many possibilities of emerging pedagogical applications in order to improve quality of STEM teaching and learning for school education.

To maximise the rhythm of STEM learning and teaching process, educators and researchers increasingly highlight the potential merits of using educational technology to improve STEM learning outcomes (Wu and Anderson, 2015). Nowadays, there is a call for the new development of mobile-assisted learning environments which allows learners to experience new learning situations beyond the classroom, and offers learners a new way to infuse learning into daily life with adaptive supports, and engage and motivate learners with anytime and anywhere learning (Srisawasdi and Panjaburee, 2019). Moreover, there is also a critical call for pedagogical applications of the mobile and ubiquitous learning technology and environment by teachers for improving the progression of student learning in STEM-oriented content matters (Srisawasdi and Panjaburee, 2016). Clearly, the effectiveness of mobile technology and ubiquitous learning environment is closely connected to the pedagogy through which they are employed. If we wish to incorporate mobile technology into school class, we must re-think on the application of appropriate pedagogy of the mobile technology use into account because mobile technology itself can influence learning under certain conditions and with a proper process.

In the recent years, mobile-oriented pedagogy has been recognised as one of the mechanisms in mobile and ubiquitous learning movement in which mobile technology and wireless communication offer several opportunities and challenges for the setting of STEM teaching and learning. To address this important issue, this special issue aims to invite researchers and practitioners who are engaged in studies to share and exchange their research and practical experiences and findings in applications of emerging pedagogies for mobile and ubiquitous learning in STEM disciplines from both research and educational practice perspectives.

This special issue offers insights into the current research, practice, and innovation in mobile technology and environment for school STEM education, and also future trends in the pedagogical application of mobile learning for STEM subjects. Some of the key themes likely to shape this special issue include the following: (1) innovations in mobile and ubiquitous learning for STEM subjects; (2) pedagogical advancements in STEM subjects with mobile devices and applications; (3) STEM curriculum development for

digital learning with mobile technology; (4) mobile and ubiquitous learning environment for STEM subjects; (5) interaction between content-specific STEM pedagogies and mobile technology; (6) innovative approaches to apply mobile technology in STEM teaching both formal and informal contexts; (7) review and theory for the applications of pedagogies in STEM-based mobile and ubiquitous learning environment; (8) discussion about re-thinking or expanding models of STEM teaching and learning in response to mobile and ubiquitous learning environment; and (9) digital learning analytics in mobile and ubiquitous learning environment for STEM education.

2 The papers in this special issue

Five papers are included in this special issue. Addressing in an empirical paper by Jingrong Xie from Truman State University, USA, "On the exploration of a mobile executive functioning coaching solution for students with and without disabilities in post-secondary STEM education", e-coaching platform supported mobile technology has been proposed to support the learning strategies and executive function skills (EFs) for post-secondary students with and without disabilities in STEM gateway courses. Using a parallel mixed methods study design, the result of this study showed improved EFs and learning strategies/skills for students who participated in this mobile EFs coaching program.

The second paper by Hwang, Li, and Lai, "Trends and strategies for conducting effective STEM research and applications: a mobile and ubiquitous learning perspective", which highlights the challenges as well as the strategies for implementing STEM activities in school settings and designing STEM research. For the present study, a preliminary review was conducted by searching the Web of Science database for the papers published in the top five educational technology journals, and the results provided informative evidence in which learning design models and guiding procedures to help teachers and researchers develop STEM activities were needed regarding the use of educational technology, and several STEM education studies can be conducted using mobile and ubiquitous learning technologies in the future.

The third paper by Xie, Basham, and Bensel, "Integrating research-based practices and mobile technology to support students with executive functioning challenges in post-secondary STEM", used Universal Design for Learning (UDL) as the guiding theoretical framework for addressing students with disabilities (SWDs)' diverse learning needs in post-secondary STEM education. The important of supporting executive function skills (EFs) and learning strategies for SWDs was emphasised. This reviewed research evidence revealed that EF challenges in post-secondary STEM education are a critical area for SWDs. The highlight is that the integration of a mobile application with research-based practices has great potential to improve EFs and learning strategies to support SWDs learning in complex learning contexts, and to support EFs development for SWDs during their learning process.

As mentioned previously, the pedagogical support of mobile and ubiquitous learning has been increasingly used to transform STEM education. Addressing in the fourth paper by Chai, Jong, and Yan, "Surveying Chinese teachers' technological pedagogical STEM knowledge: a pilot validation of STEM-TPACK survey", an attempt to integrate STEM

and Technological Pedagogical and Content Knowledge (TPACK) framework as a means to advance the state of teacher professional development for integrative STEM education has been investigated. The exploratory factor analysis and regression analysis indicated that technology-oriented TPACK factors can predict teachers' integrative STEM efficacy. To the end of this study, teachers' TPACK are associated with their efficacy in implementing STEM education.

The fifth paper by Kajonmanee, Chaipidech, Srisawasdi, and Chaipah, "A personalised mobile learning system for promoting STEM discipline teachers' TPACK development", an effect of the personalised mobile learning system on in-service teachers' TPACK has been examined. This empirical research proposed the design and development of a TPACK-oriented personalised mobile learning platform for improving the quality of teaching knowledge, regarding TPACK, for in-service STEM teachers. The results of this study indicated that the algorithms can work effectively with more than 65% of in-service science teachers' satisfaction in at least good level, and more than 90% of their satisfaction in at least moderate level. Therefore, with further improvements, this system is a promising tool for the development of teachers to be ready for todays' learning.

3 Conclusion

Owing to the dynamic growth of mobile and ubiquitous technology and the spread of wireless communication, there have created numerous new opportunities for both current and future of STEM education, and we may be able to expect major changes in the education of STEM disciplines in the next decades. However, the synergy between mobile learning technology and emerging and renovated pedagogies should be the highlight view for moving mindful STEM education of the new generation learner. We hope that, as this special issue five papers, they can be seen as complementary endeavours, each informing and improving the others and provide a critical reflection on pedagogical applications of mobile technology and environment for STEM disciplines. We believed that this issue provide a comprehensive view in both teacher and student development to improve school STEM education.

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