Mobile Learning: Reflections on the Past and Visions for the Future

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Abstract: The research field of mobile learning emerged approximately two decades ago and experienced a period of robust growth, peaking around a decade ago. However, in recent years, the research community's attention on mobile learning has shown signs of waning. This shift in focus could be attributed to the maturation and widespread adoption of mobile learning intervention methods in educational practices, rendering the field less novel and demanding. Additionally, the emergence of new technologies has prompted researchers to explore alternative avenues of inquiry, albeit often incorporating mobile learning elements into their evolving techno-pedagogical models. This panel discussion endeavors to convene early mobile learning researchers for introspection, retrospection, and foresight. Through the lens of their individual research trajectories, the panelists will critically reflect upon the past achievements, challenges, and contributions of mobile learning. Furthermore, the discussion will encompass an exploration of potential future directions and the symbiotic integration of mobile learning with novel technological advancements. The aim is to elucidate the evolving role of mobile learning in the realm of educational technology and its continuing relevance within an ever-changing landscape.

Keywords: Mobile learning; Learning log; Seamless learning; Learner data-driven paradigm; Artificial intelligence in education

1. Introduction

Mobile learning, as a specialized domain within educational technology, came into existence approximately two decades ago, accompanied by a surge of enthusiasm and pioneering research efforts (Goksu, 2021; Kukulska-Hulme & Traxler, 2005). Around a decade ago, it attained its pinnacle, marked by a proliferation of studies, innovations, and implementation projects across diverse educational contexts (Sun et al., 2020; Zubanova et al., 2021). However, in recent years, a perceptible shift in the research community's focus has become apparent, with a gradual decline in attention towards mobile learning as a discrete area of inquiry.

This shift in attention may be attributed to several interwoven factors. Firstly, the once burgeoning landscape of mobile learning intervention methods has undergone significant maturation, with many strategies becoming widely accepted and integrated into educational practices (Pishtari et al., 2020; Suárez et al., 2018). Consequently, the research emphasis on developing and validating intervention approaches has somewhat diminished, resulting in a reframing of research priorities.

Secondly, the advent of novel and alluring technologies, such as augmented reality, deep learning or generative artificial intelligence, immersive virtual environments, and learning analytics, has captivated researchers' interest, enticing them to venture into exploring the

potential of these emergent technologies in education (Goff et al., 2018; Hwang & Chen, 2023).

Amidst this evolving academic milieu, researchers who had previously been dedicated to mobile learning investigations have redirected their research agendas, while still recognizing the value of mobile learning concepts and methodologies. Many researchers have begun incorporating mobile learning elements into their novel techno-pedagogical models, recognizing the importance of leveraging mobile devices' ubiquity and contextual capabilities.

This panel discussion aspires to congregate former chairs of APSCE Classroom, Ubiquitous and Mobile Technology-Enhanced Learning (CUMTEL) Special Interest Group who have played pivotal roles in building the mobile learning community within the ICCE conference series. The intention is to engender a collective introspection, retrospection, and foresight, with the individual research trajectories of the panelists serving as case studies. Through this reflective endeavor, we seek to elucidate the transformative journey of mobile learning in the realm of educational technology and envision its potential future trajectories within the broader context of emerging educational technologies. By contemplating the past and envisioning the future, we aim to contextualize the relevance and enduring impact of mobile learning in contemporary educational research and practice.

2. Abstracts of Individual Panelists' Presentation

2.1 Mobile Learning + Learning log data = AI support + Evidence (Hiroaki OGATA)

Learning happens at anytime and anyplace. Mobile computing technologies allow us to record and analyze all the learning log data throughout mobile learning support tools (Ogata et al, 2011). The data then provides AI support for learning as well as evidence that shows scientifically significant proofs of the methodology of teaching and learning. Currently, we have been developing LEAF (Learning and Evidence Analytics Framework) system that consists of e-Book reader (BookRoll) and a learning analytics dashboard (LogPallet) (Ogata, et al, 2023). LEAF is used in K12 schools and universities in Japan as well as other countries (Ogata, et al, 2022).

Our study has the potential to revolutionize the mobile learning field by merging AI-driven data analysis with educational tools. LEAF not only provides personalized learning support but also establishes a data-centric approach to education, enabling the identification of effective teaching methods through learner data. This shift towards evidence-based mobile learning research is instrumental in harnessing technology for educational advancement on a global scale.

2.2 Seamless Learning: From a sub-field of mobile learning to a learning notion at its own right (Lung-Hsiang WONG)

Seamless learning stands out as an advanced pedagogical approach capable of catering to the evolving needs of 21st-century learners (Sharples et al., 2012). ith its remarkable ability to seamlessly traverse diverse learning landscapes spanning locations, social contexts, and technological environments, its underlying aim is to instill in students a habitual inclination to continually embark on the trajectory of learning-application-reflection through recontextualizing previously assimilated knowledge (Wong et al., 2015).

Initially, the concept of seamless learning was introduced within the realm of a distinctive form of mobile learning. Chan et al. (2006) championed the use of mobile technology in a 1:1, 24x7 environment to facilitate individual students' ongoing, cross-contextual seamless learning. This seminal work effectively inaugurated the trajectory of research and application in mobile-assisted seamless learning, a trajectory that has now extended its reach to more than 40 countries over the past two decades.

Over time, researchers' perspectives on seamless learning have shifted progressively. Initially viewed primarily from a technology-enabled (particularly 1:1-enabled) perspective (e.g., Hwang et al., 2008; Ng & Nicholas, 2007), the focus evolved to encompass curriculum design considerations (e.g., Looi & Wong, 2013; Obisat & Hattab, 2009), and eventually, the cultivation of a conducive learning culture (e.g., Milrad et al., 2013; Wong et al., 2017). This transformation indeed reflects the evolving priorities of the educational technologist community engaged with seamless learning — a shift from the creation of innovative seamless learning technologies to an exploration of the fundamental nature of seamless learning and its tangible impacts in educational institutions and among adult learners. The notion that a 1:1, 24x7 setting is an absolute prerequisite for seamless learning has been reevaluated. Recent scholarly discourse contends that seamless learning is an independent modern pedagogical concept — an aspiration (Sharples et al., 2012), a habit-of-mind (Wong & Looi, 2011) or even a set of metacognitive abilities (Sha, 2015). Consequently, alternative technological models have been introduced, such as the "division of labor" model (involving the use of distinct devices, computer setups, or even non-digital tools across different locations) (Wong, 2012; Wong & Looi, 2022) and the incorporation of (mobile) social media (Charitonos et al., 2012; Laru & Järvelä, 2015).

Looking ahead, the trajectory of mobile-assisted seamless learning offers promising avenues for exploration. Integration of immersive technologies like AR/VR and metaverse, personalized learning strategies, collaborative learning across settings, and ethical considerations are key directions that hold potential to further enhance the effectiveness and reach of seamless learning experiences.

2.3 Promises and Challenges of Seamless Learning in Learner-Data Driven Approaches (Hyo-Jeong SO)

The field of mobile learning has undergone a substantial expansion attributable to the widespread integration of mobile devices and seamless network connectivity. Almost two decades ago, a global network of mobile learning researchers collectively proposed the notion of seamless learning, denoting a continuity of learning experiences when learners are curious, across a diverse array of scenarios, facilitated through mobile devices as a main mediator (Chan et al., 2006). Subsequently, a substantial volume of research has investigated the theoretical and design underpinnings inherent to seamless learning. The key contribution of seamless learning is that the notion helped researchers and practitioners to understand (missed) learning opportunities in various informal learning contexts, supporting experiential and contextualized learning experiences.

Nonetheless, it is unclear whether the promises of seamless learning have been realized and whether mobile learning has transformed the culture of teaching and learning beyond easy access to mobile devices. In many educational settings in Asia, the utilization of mobile devices is still limited within classrooms, coupled with educators' and parents' concerns about the excessive usage of mobile devices. Selwyn and Aagaard (2021) assert that within the field of educational technology, there has been a notable lag in addressing concerns and issues linked to the utilization of mobile phones in classrooms. These concerns encompass critical matters such as cyberbullying, phone addiction, and digital distractions. Further, given the prevalence of learner data-driven approaches in mobile learning, certain underlying assumptions and challenges of seamless learning necessitate thorough reconsideration. For instance, the collection of learner data spanning various timeframes and locations is often promoted as essential for constructing seamless learning models or applications. Nevertheless, it is important for researchers and developers to uphold learners' agency, ensuring that individuals retain the right to opt out of the tracking and recording of their learning data at any point during their learning trajectory (Ocheja et al., 2019).

With this backdrop, the talk will center on the intrinsic tensions and challenges likely to confront mobile learning researchers as they adopt learner data-driven paradigms within

their design, analytical procedures, and implementation strategies. These challenges encompass the promotion of learners' curiosity and a habit of mind, a critical examination of continuity in learning experiences, the need for socio-emotional support, and the ethical use of learner-generated data in mobile learning.

2.4 Mobile Learning in the Age of Artificial Intelligence Education: A Personal Journey and Future Directions (Xiaoqing GU)

In the formative stages of our research, the spotlight was on developing resources optimized for fragmented, bite-sized learning experiences. Prior to the widespread acceptance of flipped classrooms, our investigations led to micro-learning design innovations, establishing early precedents in mobile learning (Gu et al., 2011). With the advent of blended learning, our research emphasis pivoted towards exploring the potential of blended mobile learning to facilitate student progress in these increasingly integrated learning environments (Du & Gu, 2019).

As the educational landscape transitioned into the era of artificial intelligence (AI), the role of mobile learning underwent a significant transformation in my team's research paradigm. No longer an isolated field, mobile learning became an instrumental medium to actualize AI-driven education. We believe that the essence of AI in education hinges on capturing the continuum of the learning process. By persistently tracking learners, learning trajectory across varied temporal and spatial dimensions, we can construct comprehensive learner digital profiles, ensuring individualized instruction and support (Dai & Gu, 2023).

In this schema, mobile learning stands out as more than just a mere modality—it represents flexibility, autonomy, and adaptability. As learners navigate through AI-powered educational landscapes, mobile platforms can seamlessly integrate adaptive content, empowering students to curate their learning pathways. Mobile learning can harness the power of AI to support individual learning needs and preferences, creating a dynamic, responsive, and personalized learning experience. Looking ahead, we see a future characterized by a mutually beneficial symbiosis, where mobile learning, infused with AI capabilities, will play a significant role in the evolution of education.

2.5 AI and Mobile Learning (Ting-Chia HSU)

Informed by recent research and forward-looking perspectives, the convergence of AI and mobile learning has ignited significant scholarly interest, poised to reshape the educational landscape. Pioneering investigations, such as those by Gumbheer et al. (2022), underscore AI's role in tailoring mobile learning experiences, dynamically aligning content with individual learning requirements and pace. Yazici et al. (2023) echo this sentiment, emphasizing AI, particularly machine learning algorithms, as a means to decipher student behaviors, predict performance, and propose interventions. Matzavela and Alepis (2021) delve into AI's contribution to crafting adaptive dynamic tests, juxtaposing individual student profiles with predictive models based on decision tree algorithms within mobile learning contexts. Generative AI, typified by the ChatGPT API, enriches mobile learning through interactive, personalized educational encounters. Its real-time detailed explanations and responses facilitate on-the-fly learning tailored to individual needs, buoyed by a continuous learning model that curates content via user interactions, nurturing engaging learning environments. Additionally, AI's image recognition prowess bolsters mobile learning, exemplified in Hsu et al.'s (2023) AI-aided image recognition and self-regulated learning study, which exhibited enhanced vocabulary acquisition, self-regulation, and diminished learning anxiety among third-grade students. The symbiotic fusion of AI and mobile learning heralds an era of transformative educational processes, offering exciting prospects for future exploration.

3. Discussion and Conclusion

The journey of mobile learning, spanning more than two decades, has transformed from an enthusiastic niche to a driving force in educational technology. Initially marked by pioneering research, it reached its zenith about a decade ago with a surge in studies and innovations across diverse contexts. However, the research landscape has since shifted, influenced by factors like the maturation of mobile-assisted intervention methods and the allure of emerging technologies such as deep learning and learning analytics.

The panelists' presentations underscore this evolution. Hiroaki Ogata's work integrates AI with educational tools, creating evidence-based mobile learning. Lung-Hsiang Wong's insights into seamless learning show its shift from technology-centric to a broader pedagogical concept, with immersive technologies and personalized learning strategies enhancing its potential. Hyo-Jeong So emphasizes the challenges and promises of seamless learning, especially in data-driven paradigms.

Xiaoqing Gu's perspective demonstrates mobile learning's transformation into a facilitator of AI-driven education. Ting-Chia Hsu's insights highlight AI's role in tailoring learning experiences. In conclusion, mobile learning's journey reflects its adaptability within emerging educational paradigms. The discussion offers valuable introspection and future insights, showcasing mobile learning's enduring impact on education.

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