Research Report

Social Mobile Learning with 21st century learning

for Thailand Education 4.0

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Abstract (English)

The Thailand 4.0 initiative aims to transform the country into a digital economy, and education reform is a crucial component of this transformation. Social mobile learning has the potential to play a key role in supporting education reform and the Thailand 4.0 initiative. However, previous studies have shown that while some groups have engaged effectively with social mobile learning, others have not. In this paper, we will examine the relationship between education reform, the Thailand 4.0 initiative, and the potential of social mobile learning. We will also explore the challenges of communication for sustainability, the importance of reflection in understanding complexity, the role of design thinking in teaching sustainability, and examples of teaching for sustainable development in the context of Thailand 4.0 and social mobile learning. The findings of this study suggest that social mobile learning has the potential to support education reform and the Thailand 4.0 initiative, but that engagement with social mobile learning can vary among different groups. Incorporating teaching for sustainable development into the education system in Thailand 4.0 can help to promote a culture of sustainability.

Abstract (Thai)

ความคิดริเริ่มไทยแลนด์ 4.0 มีเป้าหมายเพื่อเปลี่ยนประเทศไปสู่เศรษฐกิจดิจิทัล และการปฏิรูปการศึกษาเป็นองค์ประกอบสำคัญของการเปลี่ยนแปลงนี้ การเรียนรู้ผ่านมือถือทางสังคมมีศักยภาพที่จะมีบทบาทสำคัญในการสนับสนุนการปฏิรูปการศึกษาและความคิดริเริ่มประเทศไทย 4.0 อย่างไรก็ตาม การศึกษาก่อนหน้านี้แสดงให้เห็นว่าในขณะที่บางกลุ่มมีส่วนร่วมอย่างมีประสิทธิภาพกับการเรียนรู้ผ่านอุปกรณ์พกพาทางสังคม แต่กลุ่มอื่นๆ กลับไม่เป็นเช่นนั้น ในบทความนี้ เราจะตรวจสอบความสัมพันธ์ระหว่างการปฏิรูปการศึกษา การริเริ่มประเทศไทย 4.0 และศักยภาพของการเรียนรู้ผ่านมือถือทางสังคม นอกจากนี้ เราจะสำรวจความท้าทายของการสื่อสารเพื่อความยั่งยืน ความสำคัญของการสะท้อนความเข้าใจในความซับซ้อน บทบาทของแนวคิดเชิงออกแบบในการสอนเรื่องความยั่งยืน และตัวอย่างการสอนเพื่อการพัฒนาอย่างยั่งยืนในบริบทของไทยแลนด์ 4.0 และการเรียนรู้ผ่านมือถือทางสังคม ผลการวิจัยนี้ชี้ให้เห็นว่าการเรียนรู้ผ่านมือถือทางสังคมมีศักยภาพในการสนับสนุนการปฏิรูปการศึกษาและความคิดริเริ่มไทยแลนด์ 4.0 แต่การมีส่วนร่วมกับการเรียนรู้ผ่านมือถือทางสังคมอาจแตกต่างกันไปในแต่ละกลุ่ม การผสมผสานการสอนเพื่อการพัฒนาที่ยั่งยืนเข้ากับระบบการศึกษาในยุคไทยแลนด์ 4.0 สามารถช่วยส่งเสริมวัฒนธรรมแห่งความยั่งยืนได้

CHAPTER 1 Introduction

The United Nations' Sustainable Development Goals (SDGs) are a set of 17 ambitious goals aimed at ending poverty, protecting the planet, and ensuring peace and prosperity for all by 2030. Effective communication is a crucial aspect of achieving these goals, and social mobile learning has the potential to play a major role in this effort. Numerous calls for more sustainable living and business practices have led to numerous learning interventions to teach sustainability more effectively. Education for Sustainable Development (ESD) was first established by the United Nations (UN) in 1992 as part of a policy-driven agenda. UNESCO noted that ESD must not only encourage changes in attitudes, but also in the knowledge, skills, and values of people in order to create a more sustainable society for all individuals (United Nations, 2015).

Although the objectives of ESD are clear, how to achieve these objectives has been the subject of much more discussion. Savage et al. (2015) said that sustainability education should provide knowledge as well as skills and personal/emotional attributes to facilitate sustainable behavior. In essence, teaching must focus more on being transformative rather than transmissive (Savage et al., 2015). Researchers have emphasized that the “wicked” nature and complexity of sustainability-related problems means that knowledge is not enough (Chen & Liu, 2020; Lotz-Sisitka et al., 2015). In fact, many scholars have argued that effective learning of sustainability must not only develop new knowledge, but stimulate changes in attitudes and behaviors among a diverse group of individuals (Mogensen & Schnack, 2010; Olsson et al., 2020; Sass et al., 2020). Social mobile learning refers to the use of mobile technology for educational purposes, typically in a social context where learners can interact with each other and with the content. The use of social mobile learning can help to increase access to education

and training, especially in underserved communities, and promote sustainable development by providing learners with the skills and knowledge they need to contribute to a more sustainable future. It has the potential to enhance engagement, motivation, and collaboration among learners and to support the development of a more sustainable and equitable society.

Thailand in particular, with its Thailand 4.0 initiative, has been one of the countries that has been most enthusiastic about developing its education system to meet the demands of sustainable development. However, Thailand has also encountered several challenges with adapting their education system. In addition to unequal access to social media, Thailand has also had mixed results with regards to the use of social media in teaching and learning. Not unlike other countries, Thailand has struggled to motivate teachers to adopt social media into their teaching practices, and educate different stakeholders on how social media and mobile learning should be implemented. By exploring the potential of social mobile learning to support the SDGs, this paper aims to provide insights into how this technology can be leveraged to promote sustainable development and how social media and mobile technologies can make a positive impact in both Thailand and the rest of the world.

CHAPTER 2 Literature Review

The literature review of the paper on 'Thailand 4.0 and Social Mobile Learning' aims to provide an overview of existing research on the potential impact of social mobile learning on education reform in the context of the Thailand 4.0 initiative. The literature review will also discuss what has been learned so far about the use of mobile learning and social media for education, as well as examine the benefits and challenges of using social mobile learning. The chapter will also investigate how mobile learning and social media can contribute to education for sustainable development. The literature review chapter will conclude with the development of research questions and a description of the social mobile learning activity that was piloted in this study to gain some initial results to this research topic .

Perspectives on Learning for Sustainability

Research has discussed the critical role that universities have in contributing to sustainable development (Corvers et al., 2016; Wyness & Dalton, 2018). In their study of Education for Sustainable development (ESD), Corvers et al. (2016) emphasized that a majority of graduates will not work as academics, but will be employed in government, business, and civil society working in a variety of sustainability-based contexts. Scholars have argued that attitude, knowledge, and skill development must be developed to achieve learning outcomes (Lotz-Sisitka, Wals, Kronlid & McGarry, 2015; Olsson, Gericke, Sass, & Boeve-de Pauw, 2020; Sass et al., 2020). Brundiers and Wiek (2017) further argued that this demand for sustainability competencies has been increasing rapidly with the recognition that students will need actionable knowledge related to global sustainability challenges now and in the future, not just theoretical knowledge.

Wiek et al. (2015) operationalized the key competencies into five different categories. These include the key competencies include the ability to see sustainability problems across different sectors (systems thinking), the ability to anticipate how sustainability problems might occur (futures-thinking), and the ability to compare, reconcile, and negotiate sustainability values (values-thinking). Two other key competencies according to Wiek et al. (2015) are the ability to develop plans to mobilize resources to address sustainability issues and the ability to facilitate different types of collaboration (Wiek et al., 2015). Although these competencies have been identified, these professional skills required to meet sustainability challenges in the changing workplace are not always taught in higher education (see also Foucrier & Wiek, 2019).

On a similar note, there have been some challenges with understanding what kind of teaching activities would be most useful for developing the desired competencies among students. Research has generally agreed that two things are essential to meeting the challenges for education for sustainable development. First, that teaching and learning in this context must address real-world sustainability issues, with Corvers et al. suggesting that learning environments must allow students to learn by doing, but also learn by reflection (Corverrs et al, 2016). Corvers et al. (2016) further suggested that student centered learning strategies could provide a powerful setting for building the key competencies, and citing research by Dolmas and Schmidt (2010), stated that it should be based on four learning principles: Constructive learning, collaborative learning, contextual learning, and self-directed learning.

In terms of these four learning principles, scholars have reported on relevance of these learning principles to sustainability education. For example, Corvers et al. (2016) argued that constructive learning would enable students to construct their own knowledge base by connecting new information with existing knowledge, especially through discussion. Dolmans and Schmidt

(2010) in a study of medical education, another complex field similar to sustainability, found that traditional lectures had become too focused on memorizing facts and not enabling students to learn how to solve real-world problems. This led to a focus more on constructive learning, and an emphasis on problem based learning that will be discussed more later (Corvers et al, 2016; Dolmans & Schmidt, 2010).

Another emphasis has been on collaborative learning, a pedagogical approach that involves students working together to achieve shared learning goals (Johnson & Johnson, 1999). Collaborative learning is grounded in the social constructivist theory, which posits that knowledge construction occurs through social interaction and negotiation (Vygotsky, 1978). By engaging in collaborative learning activities, scholarship has argued that students develop important 21st-century skills such as communication, teamwork, and interpersonal skills (Corvers et al, 2016; Dillenbourg, 1999; van Mierlo & Beers, 2020). Research has shown that collaborative learning can lead to improved learning outcomes and increased student satisfaction (Johnson & Johnson, 2009). Research on sustainability education, have also indicated that collaborative learning has value for building the intended sustainability competencies (Brundiers & Wiek, 2013). The two other key concepts are contextual learning and self-directed learning. Corvers at al. (2016) stated that contextual learning is the idea that students should learn from relevant contexts and cases in order to allow students to apply insights and knowledge to different cases. Other research has also increasingly emphasized that teaching must not just be at the conceptual level, but must also be contextualized in real-world problems (Brundiers & Wiek, 2013; Quelhas et al., 2019; Wyness & Dalton 2018). Finally, self-directed learning is the idea that students should learn to regulate their learning by playing an active role in planning, monitoring, and evaluating their learning process. Combined, these four learning principles have

become integral parts of two types of learning: problem-based learning and project-based learning.

Problem-based and Project-based Learning (PPBL)

Two particular types of learning have been mentioned frequently within sustainability education: problem-based learning and project-based learning (Brundiers & Wiek, 2013; Corvers et al., 2016; Wyness & Dalton). Corvers et al. (2016) highlighted that problem-based learning and project-based learning incorporated the four learning principles discussed above and have been used increasingly in response to calls for innovation and transformation in sustainability education (Corvers et al., 2016). The authors noted that problem-based and project-based learning could shift learning from being passive to active, and would enable students to work on real-world problems by engaging in small group work (Corvers et al. 2016).

Problem-based learning (PBL) is an instructional approach that emphasizes the use of real-world problems as a context for learning (Barrows, 1996). PBL encourages students to develop critical thinking, problem-solving, and self-directed learning skills by working in teams to investigate complex, ill-structured problems (Hmelo-Silver, 2004). PBL has been widely adopted in various disciplines and educational settings, and research has demonstrated its effectiveness in promoting 21st-century skills and competencies (Savery, 2006). Project-based learning has been traditionally defined as an inquiry-based instructional method that engages learners in knowledge construction by having them achieve meaningful projects and develop real-world products (Guo et al., 2020). Research has argued that project-based learning can develop both self-directed learning and innovative thinking among students (Martin, Potocnik & Fras, 2017). Guo et al. (2020) did also note similarities between problem-based and project based learning. However,

the similarities have also led to several sustainability programs to implement a combination of problem and project-based learning (PPBL) in their own courses.

Brundiers and Wiek (2013) noted an increase in both problem and project-based learning and suggested that PPBL courses be defined broadly as a variety of teaching and learning settings that could include seminars, workshops, case-studies, and studios. In terms of similarities and differences, the authors noted while there are several differences, such as problem-based learning being more focused on being a learning tutorial vs project-based learning being more focused on project management, the two learning approaches share several commonalities (Brundiers & Wiek, 2013). For example, both learning approaches help engage students in real-world tasks, emphasize student centered and small group work, while simulating a professional setting (Brundiers & Wiek, 2013; Corvers et al., 2016).

On a related note, it should be emphasized that small group work has not always resulted in positive learning outcomes for students. Related research on team-based learning has indicated that there are actually several challenges with team-based learning in any context. Students can be disengaged and "free-ride," leading the most capable students to reduce their input when faced with working with students who do not 'pull their weight" (Michaelsen & Sweet, 2008; Watkins, 2018; Wyness & Dalton, 2018). Watkins et al. (2018) noted that there have been satisfactory and unsatisfactory experiences with team-based learning from other disciplines (Watkins et al., 2018). Wyness and Dalton (2018) noted that there have also been questions on group selection, optimal team size, as well as how ethnicity and gender mix can have an impact on groups.

Due to these issues, several authors have made recommendations on how to properly facilitate team-based learning. For example, Clark et al. (2021) argued that orienting students to team-based learning is particularly crucial for online courses (Clark et al., 2021). Michaelsen and Sweet (2008) suggested four essential elements, such as properly forming and managing groups, student accountability, timely feedback, and assignment design (Michaelsen & Sweet, 2008). In their view, these serve as pre-requisites to the success of all team learning. As a result of this research, it is clear that educators must be careful on their assumptions regarding small group work or team-based learning, and that group work may not always result in positive learning outcomes especially if there are dis-engaged students involved in the group work.

It is clear that education for sustainable development no longer views passive learning as the most viable path forward to achieving the learning objectives and building student competencies. With the proliferation of mobile and social media technologies however, this has also led to new opportunities for PPBL to be done outside of the classroom, particularly through social mobile learning.

Social Mobile Learning: Definition and Key Characteristics

Especially in recent times, education has not only become more active, but also more geared towards blended learning, which combines online and face-to-face learning. This type of learning can take advantage of the strengths of both online and in-person learning, such as the flexibility and accessibility of online learning and the social interaction and hands-on experience of in-person learning. Blended learning can be facilitated through the use of mobile technology, such as mobile devices, which can be used to access online materials and resources and to communicate with classmates and instructors (Horn & Staker, 2015). This has been augmented by the rise of mobile learning, where students can use mobile technology, such as smartphones

and tablets, to access learning materials and resources. This type of learning can take place in a variety of settings, including online, in the classroom, or even when the students are commuting or traveling between different destinations. It has been argued that mobile learning can be an effective way to support student engagement, as it allows students to learn at their own pace and in their own environment (Kukulska-Hulme & Traxler, 2015). This section chapter provides an overview of social mobile learning, its key characteristics, and its potential impact on education.

Social mobile learning is an emerging educational paradigm that combines the use of mobile technologies and social media to facilitate learning (Cochrane, 2014). This approach leverages the affordances of mobile devices and social networking platforms to create engaging, collaborative, and student-centered learning experiences (Sharples et al., 2010). Social media platforms can facilitate student-centered learning, peer collaboration, and authentic learning experiences (Veletsianos, 2011). Through social media, students can engage in real-time conversations, share resources, and build learning communities that extend beyond the traditional classroom (Kabilan et al., 2010). Additionally, social media can support the development of essential 21st-century skills, such as digital literacy, communication, and critical thinking (Greenhow & Lewin, 2016).Social mobile learning can be defined as the integration of mobile technologies and social media tools to support teaching and learning (Cochrane, 2014).The integration of social media in education has the potential to transform teaching and learning practices by providing new opportunities for communication, collaboration, and knowledge sharing (Greenhow & Lewin, 2016). Key characteristics of social mobile learning include accessibility, personalization, collaboration, and context-awareness (Ally, 2009; Kukulska-Hulme & Viberg, 2018). Accessibility refers to the ability of learners to access learning materials anytime and anywhere using their mobile devices, while personalization

allows learners to tailor their learning experiences according to their individual needs and preferences (Ally, 2009). Collaboration in social mobile learning is enabled through social media platforms, which facilitate communication and knowledge sharing among learners and educators (Cochrane & Bateman, 2010). Context-awareness refers to the capacity of mobile devices to capture and utilize contextual information, such as location, time, and learner profiles, to enhance learning experiences (Sharples et al., 2010).

Benefits and Challenges of Social Mobile Learning

Social mobile learning offers various benefits, including increased student engagement, motivation, and learning outcomes (Crompton, 2013). Research has shown that the use of mobile technologies and social media can promote active learning, critical thinking, and collaboration among students, aligning with the objectives of 21st-century learning (Kearney et al., 2012; Greenhow & Lewin, 2016). For example, in their study on the use of Facebook for learning, Manca and Ranieri (2016) found utilizing the social media platform allowed students to mix different information and learning resources to widen the context of learning. Purvis, Rodger, and Beckingham (2020) also argued that social media can be a tool for supporting applied learning activities, and could be used as a means to engage learners with time-on-task learning and self-regulated learning. In essence, the authors argued that social media provided more opportunities for learners to develop connections and communicate without time and geographical barriers that can impact traditional classroom-online instruction. They also noted that the ease of accessing social media spaces was another key benefit for learning (Purvis, Rodger, & Beckingham, 2020).

However, social mobile learning also presents challenges, such as privacy concerns, digital distractions, and the digital divide, which may impede its successful implementation in

educational contexts (Selwyn, 2011; Vu et al., 2017). Additionally, educators may face difficulties in navigating the dynamic landscape of social media and in evaluating the quality and reliability of online resources (Manca & Ranieri, 2016). Purvis et al. (2020) also emphasized that the adoption of social media for learning can be very ad hoc, unpredictable, complex, and often only done in "pockets of innovation" driven by enthusiastic educators as opposed to being a coordinated effort across different institutions. The authors also emphasized that facilitation of this kind of social mobile learning was complex and required careful consideration of not just the appropriate platform, but also the development of social relationships with or without institutional support (Purvis, Rodger, & Beckingham, 2020). Manca and Ranieri (2016) also noted that studies have not yet proven that social media is effective at improving student learning. Citing Crook (2012), they noted there can be tensions when trying to incorporate the participatory practices with social media into formal contexts of learning, and this was also related to the reshaping of the student and teacher roles (Manca & Ranieri, 2016). They also concluded that cultural resistance, traditional visions of instruction, and lack of technical support could still be barriers that discourage academics not only from embracing social platforms, but also adopting more participatory approaches (Manca & Ranieri, 2016). Other research has also noted that educators need training and support to effectively incorporate social media into their teaching practices (Carpenter et al., 2016).

Case Studies and Best Practices in Social Mobile Learning

Understanding successful implementations of social mobile learning can provide valuable insights and inform future strategies for integrating these approaches in education. This section presents case studies and best practices in social mobile learning that demonstrate the potential of this educational paradigm in various contexts.

A study by Bosch et al. (2014) explored the use of social media and mobile devices in a project-based learning environment in a higher education context. Students used mobile devices to access course materials, collaborate on group projects, and communicate with their peers and instructors. Social media platforms, such as Facebook and Twitter, facilitated collaboration and resource sharing. The study found that the integration of social media and mobile devices promoted student engagement, critical thinking, and problem-solving skills.

Kukulska-Hulme et al. (2015) investigated the use of mobile-assisted language learning (MALL) in a formal education setting. Students used smartphones and tablets to access language learning resources, participate in online discussions, and complete language learning tasks. Social media platforms, such as WhatsApp and Facebook, were used to support peer collaboration and communication. The study demonstrated that the use of mobile devices and social media in language learning can enhance student motivation, autonomy, and language proficiency.

Carpenter et al. (2016) examined the role of social media and mobile devices in teacher professional development. Teachers participated in online professional learning networks (PLNs) using social media platforms, such as Twitter and Facebook, and accessed resources and discussions on their mobile devices. The study found that participation in online PLNs facilitated professional growth, increased access to resources, and fostered a sense of community among educators.

Based on case studies and existing literature, the successful integration of social media and mobile devices in education requires a comprehensive approach that addresses various aspects of teaching and learning. First, it is essential to align social mobile learning activities with specific learning objectives, ensuring that technology supports and enhances the educational experience (Cochrane, 2014). Creating a supportive learning environment fosters open communication, collaboration, and risk-taking among students, facilitating their engagement in social mobile learning activities (Crompton, 2013). Providing scaffolding and guidance helps learners develop the necessary skills to navigate and effectively participate in these activities (Kukulska-Hulme & Viberg, 2018). Encouraging reflection and metacognition allows learners to better understand their learning experiences and fosters self-regulated learning (Sharples et al., 2010). Finally, it is crucial to regularly assess and evaluate the effectiveness of social mobile learning interventions, informing future practice and policy decisions (Cochrane & Bateman, 2010).

All of the learning activities, similar to social mobile learning, offer different approaches to education that can be effective in different contexts and with different groups of students. By incorporating these approaches into the education system, educators can help students to learn in engaging and meaningful ways, while also taking advantage of the opportunities offered by technology.

One study (Kirschner, Strijbos, Kreijns, & Beers, 2004) aimed to explore the impact of using social media for educational purposes on learning outcomes. The research participants were students who used social media to create and share educational content, and the control group was made up of students who did not use social media for this purpose. The study found that the

students who used social media for educational purposes had improved learning outcomes compared to those who did not. This research suggests that social media can be an effective tool for promoting student learning and engagement in the educational process.

The findings of this study highlight the potential benefits of using social media in education, such as increased motivation, collaboration, and knowledge construction. It is important to note that this study was conducted in 2004 and the field of technology in education has rapidly evolved since then. Further research is needed to validate the findings of this study and to explore the impact of more recent developments in technology on student learning.

To effectively incorporate social media into education, the following recommendations are proposed:

1. Develop comprehensive policies and guidelines: Establish clear policies and guidelines for the use of social media in educational settings to address privacy concerns, cyberbullying, and other potential risks (Forkosh-Baruch & Hershkovitz, 2012).
2. Provide professional development opportunities: Offer ongoing training and support for educators to develop their social media skills and to learn about effective pedagogical practices for integrating social media in teaching and learning (Carpenter et al., 2016).
3. Foster digital citizenship: Encourage the development of digital citizenship skills among students, including online safety, digital literacy, and responsible online behavior (Ribble, 2015).
4. Evaluate the effectiveness of social media integration: Regularly assess the impact of social media use in education, both in terms of student outcomes and teacher experiences, to inform future practice and policy decisions (Manca & Ranieri, 2016).

In light of these suggestions, Thailand is actually an ideal place for testing the efficacy of social media for education, as the country is currently implementing a Thailand 4.0 initiative in which it hopes to transform both their industry as well as their education system.

Thailand Education 4.0

Thailand Education 4.0 is a policy initiative launched by the Thai government to transform the country's education system to meet the demands of the 21st century. The policy aims to promote innovation, creativity, and critical thinking among Thai students, preparing them for the challenges of the digital era (Office of the Education Council, 2017). Education 4.0 emphasizes the development of student-centered learning environments that foster collaboration, problem-solving, and communication skills, in line with global trends in education (Puncreobutr, 2016).

The primary objectives of Thailand Education 4.0 are to: (a) enhance the quality of education; (b) develop human capital for the future workforce; (c) promote lifelong learning; and (d) reduce educational disparities (Office of the Education Council, 2017). The rationale behind the policy is the recognition that Thailand needs to shift from a labor-intensive to a knowledge-based economy to remain competitive in the global market (Siritongthaworn et al., 2016). This shift requires an education system that equips students with the skills and competencies needed to succeed in the 21st century (Chaiyajit & Nokham, 2020).

Education 4.0 represents a paradigm shift in Thai education from traditional teacher-centered models to more innovative, student-centered approaches that foster active learning and engagement (Boonlua & Kongchan, 2019). This shift is informed by research demonstrating the

effectiveness of active learning strategies in promoting student understanding, retention, and transfer of knowledge (Freeman et al., 2014). Key principles of Education 4.0 include personalized learning, collaborative learning, and the integration of technology in teaching and learning (Puncreobutr, 2016).

While the Thailand Education 4.0 policy offers a promising vision for the future of Thai education, several challenges must be addressed to ensure its successful implementation. These challenges include inadequate infrastructure, limited access to technology, a lack of teacher training and support, and resistance to change from stakeholders (Sangsawang, 2019). Additionally, the gap in digital literacy between urban and rural areas presents a barrier to equitable access to 21st-century learning opportunities (Chaiyajit & Nokham, 2020).
The integration of social mobile learning into Thai education aligns with the goals of Thailand Education 4.0, which emphasizes the development of 21st-century skills, such as creativity, communication, and collaboration (Boonlua & Kongchan, 2019). By adopting social mobile learning strategies, Thai educators can leverage the affordances of mobile technologies and social media to create engaging, student-centered learning environments that foster the development of these skills (Cochrane & Antonczak, 2013).

With the rise of new technologies, education has increasingly utilized technology to meet the demands of 21st century learning. Active learning approaches have also become more welcome as the characteristics of learning have changed. There has also been an emphasis on collaborative learning, which is an educational approach that involves groups of students working together to complete a task or solve a problem. While this type of learning often takes

place in a classroom setting, it can also occur online. Collaborative learning can be facilitated through the use of social media and mobile technology, as well as through more traditional methods such as face-to-face interaction (Johnson & Johnson, 1991).The use of social media in Thai education aligns with the goals of Thailand Education 4.0, which emphasize student-centered learning and the development of 21st-century skills (Boonlua & Kongchan, 2019). Integrating social media into Thai educational practices can provide opportunities for collaborative learning, authentic learning experiences, and the development of digital literacy skills among Thai students (Srichanyachon, 2014).

ESD (Education for Sustainable Development) is another important aspect of Thailand 4.0, a national strategy aimed at transforming the country into a high-income economy through innovation, creativity, and technology. ESD aims to develop the skills, knowledge, and attitudes for individuals to live sustainably and work towards a more equitable future, addressing Thailand's environmental and social challenges. The literature suggests that incorporating ESD into Thailand 4.0 through social mobile learning can increase student engagement and motivation, but there are also challenges such as the need for teacher training and potential resistance to a shift in teaching practices. Future research is needed to examine the implementation of ESD and social mobile learning in Thai schools and its effect on student engagement and motivation (Reunamo & Pipere, 2011).

However, one of the major challenges is the effective communication of the importance of sustainability to a wide range of stakeholders. These challenges can be further complicated due to language barriers, lack of access to technology, and limited understanding of the importance of

sustainability can all pose challenges to the effective communication of sustainable practices in Thailand 4.0 and mobile learning. Suwannakarn et al. (2021) found that language barriers limit access to information about sustainable practices, particularly for non-fluent Thai speakers. Jiraphongsa et al. (2020) revealed a lack of awareness and understanding of sustainability among many individuals in Thailand, which can result in limited engagement with sustainable practices. These challenges can hinder the success of the Thailand 4.0 initiative and the use of mobile learning as a means of promoting sustainability (Wongwiwatthananukit et al., 2019, 1047-1058).

In terms of how to approach teaching sustainability, research has suggested design thinking as a way to address the complexity of sustainability. Design thinking is a problem-solving approach that can be used to develop innovative and effective ways of teaching sustainability in the context of Thailand 4.0 and mobile learning. A study by Wongwiwatthananukit et al. (2022) found that design thinking can increase student engagement in the process of sustainable development, encourage active involvement in promoting sustainability, and deepen understanding of the complex issues involved in sustainability.

There are several examples of how different teachers have approached teaching sustainability. A study by Suwannakarn and Wongwiwatthananukit (2021) found that project-based learning can be an effective way of teaching for sustainable development in the context of Thailand 4.0. Students can work on real-world projects that address sustainability issues and develop solutions to these issues. Moreover, studies have also started to look at the impact of mobile learning apps. For example, the "Sustainability Challenge" app developed by the Ministry of Education in Thailand provides students with information on sustainability and challenges them to take

actions to promote sustainability. Research has also noted the importance of community engagement in sustainability learning, and students working with local communities to identify sustainability issues and develop solutions to these issues.

Teaching for sustainable development has been a key aspect of promoting sustainability in Thailand 4.0. The examples of teaching for sustainable development discussed in this chapter demonstrate the potential impact of this approach on the success of Thailand 4.0 and its ability to achieve sustainable development. By incorporating teaching for sustainable development into the education system in Thailand 4.0, the country can take a step towards a more sustainable future (Suwannakarn & Wongwiwatthananukit, n.d., 24-31). In order to achieve these goals, Thai educational institutions have already investigated a variety of methods to better educate students and achieve the Thailand 4.0 objectives.

Mobile Learning in Thailand

Mobile learning has gained increasing attention in Thailand as a means of supporting the goals of Thailand Education 4.0, which include fostering 21st-century skills and promoting student-centered learning (Boonlua & Kongchan, 2019). This chapter provides an overview of the state of mobile learning in Thailand, including its adoption, implementation, and effectiveness in the Thai educational context.

The adoption of mobile learning in Thailand has been driven by the increasing availability of mobile devices, Internet access, and the growing recognition of the potential of mobile technologies to enhance teaching and learning (Suwannatthachote & Hetrakul, 2015). Various initiatives have been implemented to promote mobile learning in Thai schools and universities,

such as the "One Tablet per Child" program, which aimed to distribute tablets to primary school students across the country (Donn & Almekhlafi, 2016). It should be emphasized that the initiatives have not just been limited to the provision of new devices such as tablets or new computers. In fact, several Thai universities have integrated mobile learning into their curricula, offering online courses and mobile learning platforms to support student learning (Boonlua & Kongchan, 2019).

Research on the effectiveness of mobile learning in Thailand, however, has yielded mixed results. Some studies have reported positive outcomes, such as increased student engagement, motivation, and achievement (Wiriyachitra, 2012; Saekow & Samson, 2011). However, other studies have highlighted challenges, such as insufficient infrastructure, inadequate teacher training, and limited access to mobile devices and Internet connectivity, which may hinder the successful implementation of mobile learning in Thailand (Sangsawang, 2019; Suwannatthachote & Hetrakul, 2015).

The implementation of mobile learning in Thailand faces several barriers and challenges, including inadequate infrastructure, lack of teacher training and support, and resistance to change among stakeholders (Sangsawang, 2019). Additionally, the digital divide between urban and rural areas may exacerbate existing educational disparities, as students in rural areas may have limited access to mobile devices and reliable Internet connectivity (Chaiyajit & Nokham, 2020). Overcoming these challenges will require concerted efforts from policymakers, educators, and other stakeholders to ensure equitable access to mobile learning opportunities for all Thai students (Suwannatthachote & Hetrakul, 2015).

The integration of mobile learning in Thailand has the potential to support the objectives of Thailand Education 4.0 by providing students with accessible, personalized, and engaging learning experiences (Boonlua & Kongchan, 2019). To ensure the successful implementation of mobile learning in Thai education, it is essential to address the barriers and challenges discussed in this chapter, such as inadequate infrastructure, limited teacher training, and digital divides. By addressing these challenges, Thai educators can leverage the affordances of mobile learning to foster the development of 21st-century skills and competencies among students. As social mobile learning continues to evolve, it is essential for educators and policymakers to stay informed about emerging trends and their potential implications for Thai education, especially for achieving the Thailand 4.0 objectives. It also appears professional development and support of higher education instructors has been lacking in this area. Therefore, the final section will detail teacher professional development and support.

Teacher Professional Development and Support

While there is some evidence that social media can help create better engagement with learning about complex sustainability issues (Brundiers & Wiek, 2013; Corvers et al., 2016), effective integration of social mobile learning in education does also require adequate teacher professional development and support. Crompton (2013) reported that the successful implementation of social mobile learning in educational settings is dependent on the skills, knowledge, and confidence of educators (Crompton, 2013). Teacher professional development is crucial for ensuring that educators are equipped with the necessary pedagogical and technological skills to effectively integrate social mobile learning into their teaching practices (Puentedura, 2010). In particular, the vast range of new tools available to teachers makes it even more necessary for teachers to not

only be trained in various learning pedagogies, but also in how to incorporate learning technologies into their teaching.

Several approaches can be employed to support teacher professional development in social mobile learning, including. For example, Ertmer and Ottenbreit-Leftwich (2010) suggested that workshops and seminars can provide opportunities for educators to learn about social mobile learning tools and strategies, as well as to collaborate with peers and share best practices (Ertmer & Ottenbreit-Leftwich, 2010). Other research however has also emphasized that communities need to be formed online, as Carpenter (2016) stated that online professional learning communities, such as those facilitated through social media platforms, can offer ongoing support, resources, and networking opportunities for educators (Carpenter et al., 2016).

Along with this, Desimone (2009) suggested that mentorship and coaching programs can pair experienced educators with less experienced colleagues, providing personalized guidance and support in the implementation of social mobile learning (Desimone, 2009). Many of these recommendations in fact, are based on nurturing self-directed learning among educators. By encouraging educators to engage in self-directed learning through online resources, research, and experimentation, this can help promote ongoing professional growth and adaptability (Kop & Hill, 2008).

Research has also discussed how to effectively facilitate teacher professional development in social mobile learning. For instance, Guskey (2003) recommended that professional development be aligned with school goals and ensure that professional development efforts align with the

broader goals and vision of the educational institution (Guskey, 2003). Avalos (2011) further suggested that institutions needed to provide ongoing support and opportunities for collaboration and reflection throughout the implementation process (Avalos, 2011).

Puentedura (2010) also suggested a focus on pedagogy, and mentioned specifically that teachers should focus on the pedagogical implications of social mobile learning, rather than focusing solely on the technology (Puentedura, 2010). The author emphasized it was not simply about learning how to use the technology, but also about understanding how to utilize the technology in the context of teaching and learning. Finally, Dweck (2008) mentioned that educational institutions needed to foster a culture of learning how to teach among educators. She emphasized it was important to not only foster a growth mindset among educators, but help them be open to changes such as new media technologies (Dweck, 2008).

In summary, while it is evident that social media is widely accessible, there is still a lack of understanding about how to utilize it effectively in the teaching and learning context. Instructors are not always trained on how to utilize these technologies, and there are several barriers that can make it difficult to implement social media into learning activities. Therefore, this study sought to investigate how sustainability education could be augmented through the use of social media.

Conceptual framework

Understanding the theoretical underpinnings of 21st-century learning is crucial for effectively implementing and evaluating educational practices. This chapter reviews key theoretical frameworks that inform 21st-century learning, particularly project-based and problem-based learning (PPBL).

Based on the previous literature, this research sought to investigate the effects of social mobile learning for the education of sustainable development. According to past literature, problem and project-based learning can help students learn how to work together to solve complex problems (Brundiers & Wiek, 2013). Research has also indicated that students working on a real-life problem such as in many cases in problem-based learning can lead them to be more engaged with learning and have better learning outcomes than from learning passively through lectures (Corvers et al., 2016; Dolmans & Schmidt, 2010; Wyness & Dalton, 2018). Literature has also argued that utilizing social media as part of the learning activities is also effective for stimulating more discussion and collaboration between students (Corvers et al., 2016; Wyness & Dalton, 2018). However, research on learning for sustainable development and social mobile learning have highlighted several challenges. For example, language issues can make it difficult for non-native English speakers to fully comprehend sustainable practices, and the complex nature of sustainability issues can also make it hard to engage students with sustainability and how it should be achieved (Brundiers & Wiek, 2013).

While research has indicated that project-based learning can create better student outcomes and help them learn more effectively (Guo et al., 2020), there has also been research that indicates collaborative learning is not always effective. This is particularly true if some students are not engaged with the learning activity, and this can have adverse effects on the other students working with them (Michaelsen & Sweet, 2008; Watkins et al, 2018). To further understand how problem-based and project-based learning (PPBL) applied to a real-life context can aid in the learning of sustainable development for Thai students, the study used the following framework to study.

According to past research, learning activities for sustainability should be based on real-life contexts and feature students working together as opposed to listening to an instructor lecture (Brundiers & Wiek, 2013; Corvers et al., 2016). Therefore, this research centered on an original learning activity in which students would research a sustainability issue such as climate change or fast-fashion pollution, then post a solution to this sustainability problem on a private social media platform for further comment and suggestions for improvement. As shown in Figure 1, the undergraduate students completed a video pitch of a solution to any sustainability problem, but also had to provide comments and critiques on the video pitches produced by other teams. They were then evaluated based on the quality of pitch videos and the critiques that were posted by the students for further improvement of the videos produced by the students.

Through the activity, the researchers were able to understand to what extent PPBL learning conducted with teams helped with improving the student understanding of pitching sustainable solutions and understanding the keys to pitching effectively. The researchers were also able to more critically investigate the effectiveness of the activity for student learning, and to what extent this activity was an improvement on the previous learning activities done by the instructors that were more based on lectures of explanation of sustainability and pitching, without necessarily utilizing design thinking as part of the overall approach. This would also provide further understanding of how teachers should implement these active learning approaches in class, and what factors need to be considered when doing similar PPBL activities in other contexts.

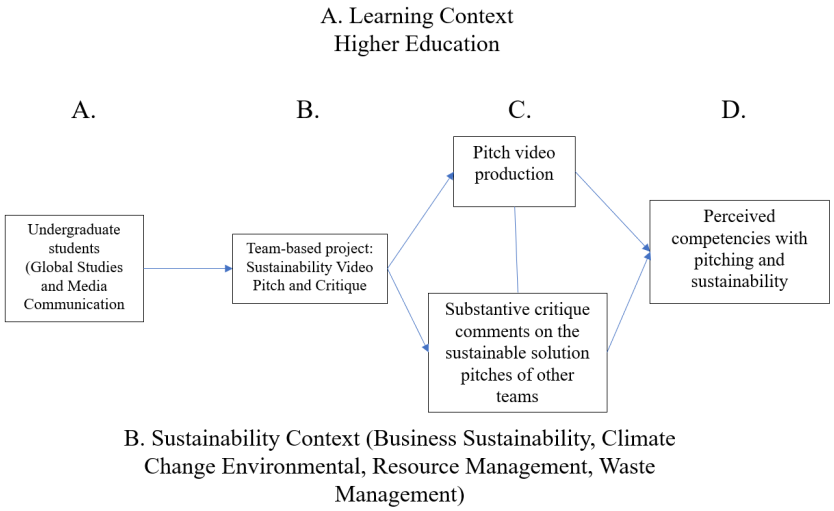

Figure 1. Conceptual framework for sustainability learning activity

Based on this framework, the research questions were as follows:

1. Did students exhibit improvement in their understanding of pitching a sustainability solution to the instructors?
2. Did students engage with the activity through “higher-level” commenting on the pitch videos of their peers and final reflection videos?
3. Did the instructors perceive better engagement among the students with learning about sustainability and sustainability solutions?

CHAPTER 3 Methodology

To further understand the impact of social mobile learning on the teaching of a sustainability subject, a social mobile learning activity was done at a Thai University with a class of first year students in a Creativity and Communication course. The activity was the second iteration of a similar video activity that was analyzed through focus groups (Wang & Funk, 2021), and was improved based on the feedback from these focus groups before it was empirically investigated.

The social mobile learning was on a private video sharing platform called Soqqle, which is similar to TikTok in that it allows students to scroll through videos, like, and comment on them seamlessly (Figure 2).

Figure 2. Example of Sustainability Solution Pitch Video posted on Soqqle

For the activity process (Figure 3), students formed teams to think about significant issues related to sustainability such as fast fashion, marine pollution, and sexual harassment. They then

conceptualized solutions to these sustainability problems and created short pitch videos of their solutions they posted on Soqqle for the classmates to comment and critique. Based on the feedback they received on their first pitch videos, the students would then go back and create a second improved version of their pitch video for the students to comment on to see improvement. After the two pitch videos, the students then prepared a final pitch of their sustainability solution to the class, and posted final reflection videos on what they learned from the activity.

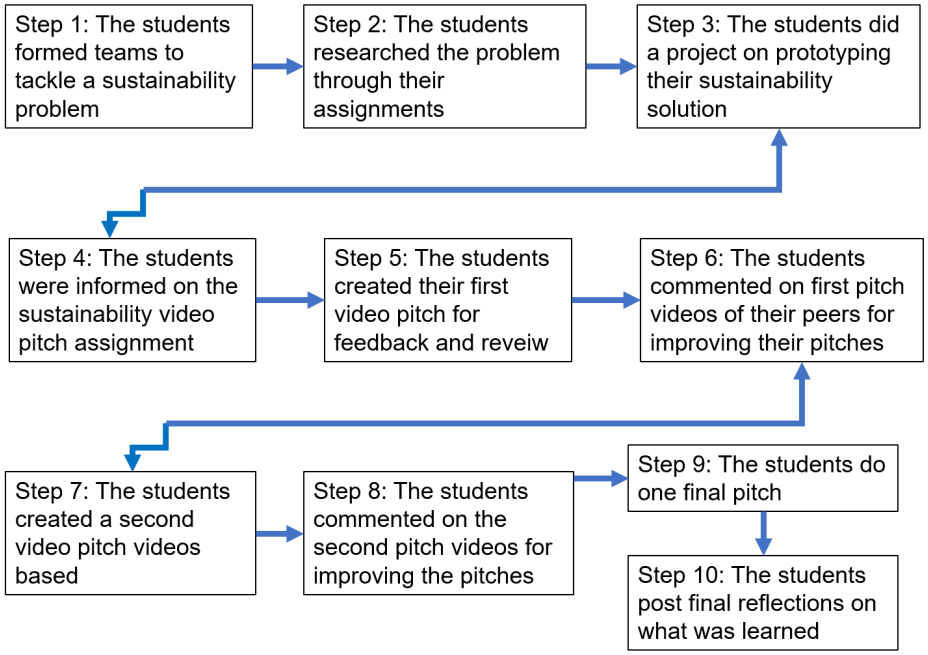

Figure 3. Social Mobile Learning Activity Process

Sampling

The participating students were first year students from two different faculties of a Thai university studying global studies or media communication. There was a mix of Thai and international students who participated from Myanmar, Russia, and Cambodia. Students were

informed of the study beforehand and were asked to provide their consent through their participation in the activity.

Data Collection and Analysis

The pitching videos were objectively evaluated by two instructors of the course in terms of the quality and improvement. The comments were also evaluated in terms of quality from the context of did they simply comment on superficial parts of the video such as critique the editing or the presenting style of the speaker, or did they actually ask substantive questions regarding the clarity of the pitch or how the sustainability solution pitched was supposed to work and be effective. The final reflection videos were also graded by the instructors in terms of how many students posted the final reflection videos, and the quality of the reflections posted by the students. To further supplement this data, instructors also provided their observations on how students performed at each key step of the activity, and some of the challenges they observed with the students completing the activity. In total, seven pitch videos were produced by the teams that were further analyzed as part of the study.

CHAPTER 4 Results

For the first research question, the results were generally mixed. Although four of the groups showed steady improvement in terms of the quality of their pitch videos, the instructors observed that two of the teams did not improve the quality of the sustainability solution pitch videos. The four exemplary groups improved greatly on focusing their second pitch videos after receiving the feedback from their first pitch videos, and also improved on making a persuasive argument for why their sustainability pitch solution would be effective. The two groups that did not excel at

the activity both had challenges not necessarily with understanding the assignment or posting the videos, but with following directions provided by the instructors.

One of the groups posted two pitch videos that had a similar problem in that they were more both focused on video editing style rather than on describing what their sustainability solution actually was. The other group simply posted a video of the students using various video filters and effects that were unrelated to their sustainability problem of marine pollution. The second video from this particular group was also more focused on video editing effects rather than on clearly describing and persuasively pitching the sustainability solution to their peers. The fact that there were groups who performed very well and followed directions precisely indicated that this was not a case of the students not receiving clear instructions, but may have been a lack of engagement with the activity or desire to work in their small groups.

Surprisingly, one group improved on the quality of their sustainability solution pitch video for a new mental health counseling app, but then failed to do a proper pitch presentation despite clear directions to do a proper final pitch of the sustainability related solution. The students said that there was a misunderstanding on the assignment and they ended up doing a reflection presentation instead which was not the assigned task. Overall, only about 58% of the student groups performed on the activity in an exemplary manner, while 42% of the student groups struggled to meet the objectives of the social mobile learning assignment.

This was further evidenced by the comments that were posted by the students. While some of the comments were helpful in the eyes of the instructors, quite a few of the comments were

superficial, repetitive, or did not provide any substantive feedback on the sustainability solution, leading to questions as to whether they were really engaged with the assignment or simply posting comments in order to complete the given assignment. These type of “not so helpful” comments tended to focus on the speech delivery of the presenter in the pitch videos, or the overall video editing quality as opposed to critiquing the sustainability solution pitch structure, which was the primary learning objective for the students from this activity.

In terms of the reflection videos, a majority of the students did not complete the reflection videos to discuss what they learned, with only about 31% of students completing the final reflection videos. The lack of posted reflection videos indicated a lack of students' engagement with the activity, but it may also have been a lack of engagement with the course in general.

In terms of what the instructors observed about the activity. The instructors noted that the social mobile learning activity was effective for quite a few students. They said that in the past, they usually just explained and showed demonstration to students of how to do a pitch which led to some challenges. For example, students would focus more on speech delivery with their pitches, but did not necessarily focus on important details such as clearly describing what their solution was or how it worked. However, the social and design-thinking oriented focus of the activity enabled students to experiment with creating their pitch videos, and receive comments from their peers and instructors on how to make their pitch videos more effective and clear. By allowing students to practice and experiment as opposed to just submitting one pitch video for a grade, the students were able to review what they learned about sustainability and pitching, and also

experiment in applying what they learned in a safe environment. This was a noted strength of the social mobile learning activity from the instructors.

However, the instructors also noted that the activity did not really seem to motivate the dis-engaged students. While dis-engaged students did produce pitch videos and did comment on the videos of their peers, the feedback was not always helpful and the pitches did not always adhere to guidelines given by the instructors. The instructors also noted that they gave the students half of the class periods (1.5 hours) to work on the pitch videos and ask any questions about the social mobile learning assignment. While the exemplary groups did ask for clarifications on the assignment to ensure they met the criteria, several groups did not ask for any assistance and then did parts of the assignment incorrectly. Some of the students seemed to just be trying to complete the assignment as opposed to trying to understand how to pitch sustainability solutions in a more substantive way. The instructors noted that there may need to be more scaffolding activities or explanations for the activity in order to ensure that students do not lose focus or misunderstand key parts of the assignment. For example, one group misunderstood that the final presentation was a reflection presentation rather than a final pitch, but this was also a group that the instructors observed to be dis-engaged with doing the assignment.

The instructors also noted the team-based nature of the assignment also led to some difficulties that mobile apps cannot necessarily address. Several of the teams that underperformed in the activity featured members that did not communicate or attend class regularly. These teams tended to miss assignments and miscommunicate directions to their absent members, leading to

non-optimal performance on this team activity. This insight reveals that team-based learning may not be ideal and may lead to a lack of accountability among the students (Michaelsen & Sweet, 2008). Whether this activity would be more effective as an individual-based assignment should be explored further.

Limitations

There are several limitations with this study. First of all, it was a pilot study of an activity conducted only with students from two faculties at a Thai university. Secondly, it was conducted with first year students who were still transitioning to university students, so it is very plausible that the results would have been different with an older student sample. The results of this study may also not be generalizable to other students from different cultural backgrounds. Thirdly, the activity was done on a private and separate social media platform that students did not normally use to protect their privacy and create a safe space for them to experiment. It is possible that the engagement would have been higher had the activity utilized a more common social media application such as Facebook, but this would have also changed how the students would have viewed the and commented on the videos, which could have also had an effect on engagement. However, despite these limitations, the study yielded some interesting insights that should be explored and discussed further.

CHAPTER 5 Discussion

Overall, the study offered interesting findings on the efficacy of social mobile learning for teaching sustainability related subjects. In terms of its relative strengths, social mobile learning allows for students to engage with sustainability issues in a different way, and talk with their

peers about the viability of their proposed sustainability solutions, Moreover in this case, students were able to critique and discuss how sustainable solutions should be pitched. Students were also able to exhibit and apply their knowledge in a more active learning format, and continue their learning and collaborative discussions outside of the classroom as opposed to having to wait until the next lecture session. In this case, mobile technologies were an integral part of allowing students to connect to each other and continue their learning.

Nevertheless, the study also indicated that there are still some challenges with this type of learning. Firstly, the team-based oriented focus of this activity led to some students to be dis-engaged which has also been a reported issue with team-based learning in several other contexts (Michaelsen & Sweet, 2008; Watkins, 2018). It was apparent that simply utilizing a social mobile learning application was unable to motivate these disengaged students to participate more in the pitching activity or comment actively on the video pitches. Consequently, the teams did not all work cohesively on completing the activity. Since the platform was private and not a part of the students regular social media usage, this may have also led a few students to forget to do the assignment. This indicates that future studies may need to consider utilizing more individual-oriented activities so that students feel more accountable and do not have an opportunity to freeload or not engage with the activities like in this team-based social mobile learning activity. Whether or not this is an improvement in terms of motivating all students to be engaged with learning about sustainability is something that should be investigated further.

Overall, it was clear that only a few of the students engaged with the sustainability problems in a substantive way, while a few others appeared only focused on completing the assignment. This

indicates that a “real-world” context (Brundiers & Wiek, 2013) may not be motivating to all students, especially if they do not think that they will work in a related industry in the near future. On a similar note, the motivation of students is something that must be considered before conducting any learning activity. While studies have talked about how transformative and powerful active and social mobile learning activities can be (Purvis et al, 2020), the motivation of the students is paramount to the effectiveness of social mobile learning activities. It should not be assumed that learning activities utilizing social mobile learning will be inherently motivating to all types of students. Future studies can look more closely at what contexts social mobile learning can be most effective for teaching sustainability, and what types of learners (undergraduates, postgraduates) will benefit most from these types of learning activities.

Another important aspect to be considered is the changing role of teachers in social mobile learning environments (Koehler & Mishra, 2009). Educators need continuous professional development to effectively integrate social mobile learning into their teaching practices (Ertmer & Ottenbreit-Leftwich, 2010). It was observed in this study that the use of the social media platform was quite intuitive for the students, and they did not need a detailed tutorial in order to utilize all of the features within the social media app. It is unclear however if other instructors would feel inclined to use it, as this initiative was very much an ad-hoc initiative from two enthusiastic instructors that did not necessarily receive direct support from the institution (Purvis et al., 2020). Future studies could investigate the support structures necessary to facilitate this development and how educators can best adapt to the evolving educational landscape.

While this study was limited to students from a higher socio-economic background, it cannot be understated that there continues to be a digital divide in Thailand. This digital divide and accessibility concerns are also critical in the implementation of social mobile learning (Warschauer, 2004; Norris et al., 2013). Students from lower socioeconomic backgrounds or rural areas may have limited access to technology and the internet, which could hinder their learning experience. Future research should investigate how students from different socio-economic backgrounds react to learning through social media, and it should not be assumed that all students will respond positively to learning via social media. By researching how different learners react to social mobile learning, future research could then focus on strategies to bridge this divide and ensure equitable access to social mobile learning opportunities.

It should also not be understated that assessment and evaluation methods are critical to understanding how social mobile learning can add value to the learning experience of different students. It should also be emphasized that the realm of sustainability features many challenges. Scholars have also emphasized that assessments cannot just be of the students' knowledge or attitudes towards sustainability, but must also measure their competencies in order to better assess their critical thinking and problem-solving skills (Brundiers & Wiek 2013). While it was apparent in this study that not all students were able to engage with sustainability in a substantive way, the assessment and evaluation methods were somewhat effective at ascertaining which student groups were learning how to persuasively pitch their sustainability solutions, and which student groups were simply trying to complete the assignment. This study showed the importance of appropriate assessment and evaluation methods, and shows that assessment should

continually be adapted to measure student learning and ensure that students are effectively engaged in social mobile learning environments (Pachler et al., 2010; Chuang et al., 2018). Further studies could explore innovative assessment techniques that align with the unique characteristics of social mobile learning and provide meaningful feedback to both students and educators, while measuring the actual skill competencies in complex subjects such as sustainability.

Implementing social mobile learning in educational settings may face barriers such as resistance to change, lack of resources, and institutional constraints (Ertmer et al., 2012; Crompton et al., 2017). It is unclear at this point if this social mobile learning activity would be of interest to other instructors, and future research should not only explore the effectiveness of the activity, but also the willingness of different instructors to experiment with this type of social mobile learning technology. While this social mobile learning activity did not require many resources and was free to use for both students and instructors, it is unclear if this kind of activity would be effective for all other types of students.

While some students did express concerns with the fact this was yet another social media platform they had to use, there were privacy concerns that had to be considered, and should be explored further in future studies. Privacy and security concerns associated with the use of social media and mobile technologies in education must be addressed (Hew, 2014; Al-Samarraie, 2019). Schools and educators need to be aware of these issues and develop strategies to protect students' privacy while promoting a safe learning environment.Identifying these challenges and

developing solutions to overcome them is crucial for the successful integration of social mobile learning in teaching sustainability.

Lastly, various pedagogical approaches and strategies can be used to effectively integrate social mobile learning into the curriculum, such as problem-based learning, inquiry-based learning, and collaborative learning (Laurillard, 2012; Sharples et al., 2015). While the PPBL activity was somewhat effective for some students, it was not that effective for all learners, leading to questions as to whether it would be a viable activity in the future. Future studies could investigate the effectiveness of these approaches in the context of teaching sustainability and explore how they can be tailored to best suit different learners and educational contexts.

Conclusion

In conclusion, the study indicated that there is some potential for social mobile learning to help engage students with sustainability in a different, more collaborative way. However, student motivation and attitude still has a very large impact on the efficacy of these activities. Future research should seek to better understand how to stimulate motivation among all different types of students, and how social mobile learning activities contribute to engagement and substantive knowledge-building in the area of sustainability.

However, the effectiveness of social mobile learning is heavily influenced by student motivation and attitude. It is crucial for educators to consider the diverse needs and preferences of their students when designing and implementing social mobile learning activities. Strategies that could

enhance student motivation include personalizing learning experiences, offering choice and autonomy, setting clear expectations, and providing timely feedback (Deci & Ryan, 2000; Pintrich, 2003).

Future research should delve deeper into understanding how to stimulate motivation among various student groups, including those from different cultural, socioeconomic, and educational backgrounds. Additionally, studies should explore the ways in which social mobile learning activities contribute to engagement and substantive knowledge-building in the area of sustainability.

Furthermore, it is essential to examine the role of teachers in social mobile learning environments, as well as the support structures and professional development opportunities necessary to facilitate their transition into effective facilitators of these learning experiences (Koehler & Mishra, 2009; Ertmer & Ottenbreit-Leftwich, 2010).

By addressing these issues and building upon the findings of this study, researchers, educators, and policymakers can better understand the true potential of social mobile learning in promoting sustainability education and ultimately contribute to the development of more sustainable and equitable societies.

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