



A Systematic Review of Mobile Learning and Student's Self-Regulated Learning

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ABSTRACT

Background: Mobile learning has revolutionized how people learn by granting them access to a wealth of information and educational resources on the go, anytime, and from any location, using only their smartphone or tablet. In contrast, self-regulated learning enables students to complete their coursework. **Purpose:** This systematic review, which includes metacognitive and motivational approaches, seeks to integrate the existing literature on this topic and investigate the connection between mobile learning and students' self-organization. **Research Design / Methodology:** A systematic literature review using the PRISMA methodology was conducted, and 62 articles were included after a comprehensive screening of ERIC, PsycINFO, Scopus, and Web of Science databases.

Findings: This review suggests that mobile learning can have a positive effect on students' self-regulated learning skills and outcomes, such as increased self-regulation strategies, intrinsic motivation, and academic achievement. However, contextual factors and individual distinctions, such as technology self-efficacy, learning styles, and cognitive load, may influence the relationship between mobile learning and students' self-regulated learning. **Originality/Value:** This article examines the significance of these findings for educational practitioners and policymakers and future research directions that will expand our understanding of the relationship between mobile learning and student self-regulation.

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Introduction

Mobile learning is a form of distance education that enables students to acquire knowledge using mobile phones and other portable devices, allowing them to study at their leisure and anywhere. Due to the portability of mobile devices, "mobile learning" refers to the capacity to learn from any location (Papadakis, Kalogiannakis, & Zaranis, 2021). The widespread availability and accessibility of mobile devices have created new opportunities for learning at any time and from any location, and they have the potential to enhance self-regulated learning, a crucial skill for lifelong learning and academic success (Xia, 2022). Self-regulated learning is how students actively monitor, manage, and regulate their learning to achieve their goals (Wolters & Brady, 2020). Numerous studies have investigated the relationship between mobile learning and self-regulated learning, specifically the impact of mobile learning on self-monitoring, goal-setting, planning, self-evaluation, and self-reflection (Palalas & Wark, 2020). However, the results of these studies have been inconsistent, with some indicating a positive relationship between mobile learning and self-regulated learning and others indicating little to no association (Xu et al., 2023).

Prior research has focused primarily on specific variables associated with mobile learning and self-regulated learning, such as mobile learning usage frequency, duration, type of mobile learning activities, self-regulated learning strategies, intrinsic and extrinsic motivation for mobile learning, academic achievement, knowledge retention, and skill development (Wang, Yang, & Zhang, 2020). These characteristics have been investigated in numerous educational contexts, including K-12 education, postsecondary education, workplace learning, and informal learning environments (Greenhow et al., 2020). A systematic review of the current literature is necessary to provide a comprehensive understanding of the relationship between mobile learning and self-regulated learning and identify knowledge gaps, inconsistencies, and future research objectives (Nichter, 2021).

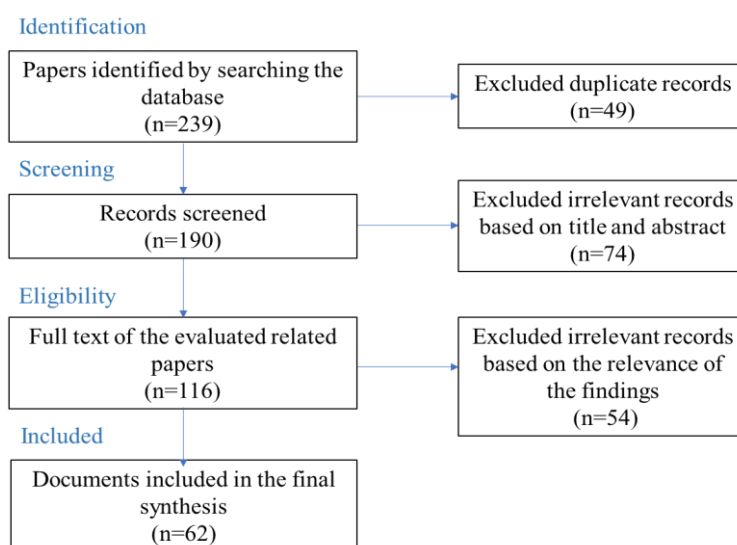


Figure 1: PRISMA model for screening.

On April 11, 2023, a comprehensive search was conducted in four electronic databases, including Scopus, Web of Science, PsycINFO, and Education Source, for publications from the last five years, from 2019 to 2023 (see [Table 1](#) and [Figure 2](#)).

(Palalas & Wark, 2020) Additional variables may influence the association between mobile learning and self-regulated learning in addition to those mentioned in prior research. Alghamdi et al. (2020) found that learners' technological self-efficacy, or belief in their ability to use technology successfully for learning objectives, may influence their engagement in self-regulated learning while using mobile devices. Additionally, learning styles, or learners' preferred ways of processing and organizing information, may moderate the relationship between mobile learning and self-regulated learning, as different learning styles may necessitate distinct self-regulated learning strategies in a mobile learning environment (Curum & Khedo, 2021).

In addition, students prior experience with mobile devices, cognitive load in mobile learning, socialization in mobile education, and self-efficacy in self-directed learning all play significant roles as mediators or facilitators in the relationship between mobile learning and self-directed learning.

This systematic review aims to provide a comprehensive overview of the current state of knowledge in this field by reviewing existing literature on the relationship between mobile technology and self-regulated learning.

Method

To accomplish this, the systematic literature assessment methodology and PRISMA standards were utilized to identify relevant material. Mobile learning AND self-regulated studying, Mobile learning AND self-regulation, Mobile studying AND self-directed studying, Mobile studying AND self-paced studying, Mobile learning AND self-tracking, etc. There were a variety of keyword combinations utilized in the inquiries. Articles were considered for inclusion in the review if they met the following criteria: (1) they addressed the relationship between self-regulated learning and mobile learning; (2) they were published in peer-reviewed journals; (3) they were written in English; (4) were published within the last five years (indicative of the years); and (5) they included empirical research or theoretical discussions pertinent to the issue. 239 articles were compiled from various sources, including 104 from Scopus, 51 from Web of Sciences, 57 from ERIC, and 27 from PsycInfo. Following the initial search, 49 duplicate articles were removed, and the remaining articles were vetted based on their titles and abstracts. For further evaluation, 62 full-text articles meeting the inclusion criteria were retrieved (see [Table 2](#) and [Figure 1](#)).

Two independent reviewers conducted the screening procedure, and disagreements were resolved through discussion and consensus.

Table 1

Publications count per year

Year	No of Publications
2019	13
2020	18
2021	15
2022	13
2023	3

A standardized exclusion form was utilized to obtain information from the included papers. The study protocols included in the inclusion criteria were evaluated using the appropriate inclusion quality assessment tool (such as the Newcastle-Ottawa Criteria for observational research or a modified version of the Critical Assessment Checklist for a semi-experimental study) from the Joanna Briggs Institute. Two impartial evaluators conducted the qualitative evaluation, and any disagreements were resolved through discussion and consensus.

Table 2

Journals Publications Trend

Publisher	No of Publications
Journal of Education, Teaching and Learning	1
Computers in human behavior	1
IEEE Access	1
Peabody Journal of Education	1
TechTrends	2
Medical Education	1
Journal of Educational Technology & Society	1
Computer-Assisted Language Learning	1
Journal of Computers in Education	1
Higher Education Research & Development	3
Teachers College Record	1
Anatolian Journal of Education	1
Journal of Applied Research in Higher Education	1
Journal of English Education and Linguistics Studies	1
International Journal of Innovation in Science and Mathematics Education	1
Beijing: Smart Learning Institute of Beijing Normal University	1
Advances in Medical Education and Practice	1
Current Psychology	4
Interactive Learning Environments	1
Education and Information Technologies	2
Journal of Computer-Assisted Learning	3
Zeitschrift für Erziehungswissenschaft	1
Educational Technology Research and Development	2
IEEE Transactions on Learning Technologies	1
Online Learning	1
Future Internet	1
Australasian Journal of Educational Technology	1
Advances in Mobile Learning Educational Research	1
Contemporary Educational Psychology	1
Sustainability	4
Frontiers in psychology	5
Technology in Society	1
The Internet and Higher Education	1
Computers & Education	3
Educational Psychology Review	4
British Journal of Educational Technology	2
Educational Research Review	1
International Journal of Emerging Technologies in Learning	2

This review elucidates the current state of research in this field, identifies gaps and limitations in the existing body of knowledge, and suggests potential future research directions. This review effectively integrates prior research into discussing the connection between mobile learning and self-directed learning (see Table 3).

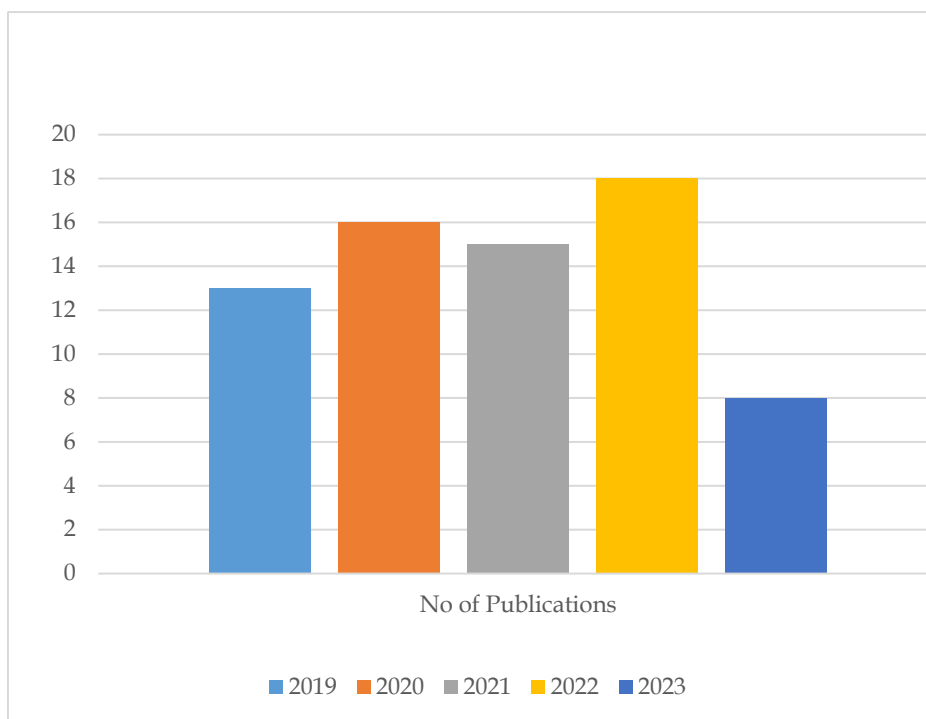


Figure 2: Publications count per year

The findings from the included articles were synthesized narratively, including descriptions of key themes, patterns, and trends regarding the connection between mobile learning and self-regulated learning. After presenting the findings descriptively and analytically, the evidence was synthesized, and conclusions were drawn based on this evidence. This systematic review has several limitations, including possible publication bias, language bias, and the exclusion of unpublished or unreviewed material. Additionally, the included articles' quality may vary, affecting the overall findings and conclusions.

Literature Review

Mobile learning refers to using mobile devices (such as smartphones, tablets, and laptops) to facilitate learning and teaching activities (Yeboah, Nyargorme, & Barfi, 2020). With the widespread use of mobile devices and their ability to support learning anytime and anywhere, mobile learning has gained significant attention in recent years. Self-regulated learning is a cognitive and metacognitive process in which students take charge of their learning by setting objectives, monitoring their progress, allocating resources wisely, and evaluating their performance (Anthonyamy, Koo, & Hew, 2020).

Table 3

Literature Review Themes

Research Questions	Description
RQ1: How well do we now understand the link between mobile learning and self-regulation?	This study seeks to investigate and synthesize current literature on the link between mobile learning and self-regulated learning, including major findings, hypotheses, and empirical data.
RQ2: How do technological factors like self-efficacy, learning style, and cognitive load influence the link between mobile learning and self-regulated learning?	The importance of various elements in defining the link between mobile learning and self-regulated learning, such as technological self-efficacy, learning styles, and cognitive load, is the subject of this research topic.
RQ3: What are the implications for educational practitioners and policymakers of the existing literature on the relationship between mobile learning and self-regulated learning?	This research topic aims to investigate the practical implications of current literature on the link between mobile learning and self-regulated learning for educational practitioners and policymakers. Based on the literature review results, it tries to give insights and suggestions, such as techniques, interventions, and policies that may be implemented in educational settings to promote successful mobile learning and self-regulated learning practices.

Growing evidence shows that mobile learning can facilitate self-directed learning (Higgins, Frankland, & Rathner, 2021). The portability and pervasiveness of mobile devices enable learners to access learning resources and participate in learning activities in flexible and individualized ways, aiding self-regulation (Karakaya & Bozkurt, 2022). Learners can, for instance, define their learning objectives, track their progress using various applications or platforms, manage their time effectively by accessing learning materials on the go, and report on their learning experiences using multimedia capabilities available on mobile devices (Li et al., 2021).

Several studies have discovered that mobile learning can enhance the self-regulated learning practices of students (Palalas & Wark, 2020). Research has shown, for example, that mobile learning improves students' ability to set objectives, self-assessments, time management skills, and metacognitive awareness, all essential components of self-directed learning monitoring (Mou, 2021). Mobile learning can also increase student motivation to participate in pertinent, interesting, and engaging learning activities, resulting in increased intrinsic motivation and self-directed learning (Luo, Lin, & Yang, 2021).

The relationship between mobile learning and self-regulated learning is complex and multifaceted (Palalas & Wark, 2020). According to Edisherashvili et al. (2022), mobile learning can facilitate self-regulated learning. However, it may also present challenges that hinder students' ability to self-regulate their learning. Difficulties include distractions, information inundation, and lack of supervision. To understand the connection between mobile learning and self-regulated learning, it is necessary to examine the current research in depth. This review should evaluate the factors that may influence this relationship, the processes by which mobile learning may influence self-regulated learning, and the advantages and disadvantages of mobile learning in promoting self-regulated learning (Matcha, Gašević, & Pardo, 2019).

This paper comprehensively analyzes the relationship between mobile learning and self-regulated learning based on a systematic review of the existing literature. In addition, the study sheds light on the fundamental processes, consequences, and potential avenues for future research and practical applications in this sector.

This study comprehensively analyzes the relationship between mobile learning and self-regulated learning.

'Frequency of Mobile learning use

Prior research has demonstrated the importance of mobile learning frequency in fostering self-regulated learning (Peeters, Saqr, & Viberg, 2020). According to a study (Chen, Chen, & Yang, 2019), students who regularly engage in mobile learning activities are more likely to develop self-regulated learning skills. Learners who regularly use mobile devices to access educational applications, online courses, or educational websites are likelier to actively monitor their progress, set learning objectives, manage their time efficiently, and reflect on their learning experiences (Ismail, 2019).

Time Spent on Mobile Learning

The time learners spend engaging in mobile learning activities has also been linked to self-regulated learning (Nichter, 2021). Using mobile learning for an extended period can, according to research (Lai & Hwang, 2021), improve the self-regulation skills of learners. Learners who spend more time using mobile devices for educational purposes are more likely to engage in self-regulatory tasks such as defining learning objectives, organizing learning activities, and evaluating learning outcomes (Joshi, Woodward, & Woltering, 2022).

Mobile Learning Activities

The mobile learning activities learners engage in can also affect their ability to self-regulate their learning (Hanif, 2020). For instance, accessing educational apps, viewing educational videos, participating in online chats, and completing exams may require varying degrees of self-regulation (Huang et al., 2020). Setting objectives, tracking progress, and evaluating performance, for instance, may be more conducive to self-regulated learning than activities that are more passive or offer fewer opportunities for learners to manage their learning process actively (Raković et al., 2022).

Strategies for Self-regulated Learning

Self-regulated learning practices that can be influenced by mobile learning include goal setting, self-monitoring, time management, self-reflection, and self-evaluation (Mou, 2021; Zhang & Zuo, 2019). Mobile devices can provide learners with tools and resources to facilitate the implementation of these strategies. Learners can use mobile applications or features such as calendars, reminders, note-taking apps, and reflective journals to set goals, monitor progress, manage time, and reflect on their learning experiences, which can aid in the development of self-regulation skills (Watanabe et al., 2020).

Mobile Learning Intrinsic Motivation

Intrinsic motivation, which refers to the intrinsic interest, pleasure, and satisfaction that learners derive from participating in an activity, has been positively associated with self-regulated learning in mobile learning (Arrastia-Chisholm & Tackett, 2020). Learners intrinsically motivated to use mobile devices for learning are likelier to engage in self-regulation processes such as goal setting, progress monitoring, and evaluating learning outcomes (Ballouk et al., 2022). Intrinsic motivation in mobile learning can be fostered in several ways, including by providing learners with choice, autonomy, relevance, and meaningful learning experiences (Nikou & Economides, 2021).

Mobile Learning Extrinsic Motivation

Extrinsic incentives, including external rewards, grades, and other factors influencing learners' engagement in an activity, can also influence self-regulated mobile learning (Wei, Saab, & Admiraal, 2023). For instance, learners who are extrinsically motivated to use mobile devices for learning may be more likely to engage in self-regulated learning practices to achieve these extrinsic incentives (Uka & Uka, 2020). On the other hand, excessive reliance on extrinsic motivation may undermine learners' intrinsic motivation and self-regulated learning skills over time (Edisherashvili et al., 2022).

Mobile Learning Amotivation

Amotivation, defined as a lack of motivation or interest in participating in an activity, can negatively affect self-regulated learning in mobile learning (Morelli et al., 2022). Amotivated learners may not actively engage in self-regulatory activities, such as goal planning, monitoring, or reflection, and may not regulate their learning process appropriately (Duchatelet & Donche, 2019). Understanding the causes of amotivation and addressing them in mobile learning environments may assist learners who are not motivated to use mobile devices for learning to develop self-regulated learning skills (Chen et al., 2019).

Academic Success

Mobile learning and self-regulated learning can influence academic achievement, which refers to students' performance in traditional educational contexts (Xu et al., 2023). Research indicates that students who engage in self-regulated learning behaviors such as goal planning, progress monitoring, and reflection on learning experiences are more likely to achieve higher academic outcomes (Huang et al., 2021). Mobile learning can empower students to engage in self-directed learning, which can positively affect their academic progress (Hanif, 2020). By employing effective self-regulated learning practices, learners who use mobile devices to access educational resources, participate in collaborative learning activities, and practice skills, for example, can improve their academic performance (Bai, 2019).

Retention of Mobile Learning Information

Mobile learning can also influence learners' knowledge retention or the extent to which they remember and implement what they have learned over time (Curum & Khedo, 2021). According to research, learners who engage in self-regulated learning activities like

elaboration, organization, and review are more likely to retain and transfer knowledge to new contexts (Guo, 2022). Mobile devices can provide the tools and resources necessary for learners to engage in self-regulated learning. Learners can use mobile applications or features such as note-taking apps, flashcards, and revision tools to elaborate on learning materials, organize information, and review topics, aiding in knowledge retention (Lai, Saab, & Admiraal, 2022).

Improvement of Abilities

Mobile learning can also help learners improve their skills through self-directed learning (Chen et al., 2019). Using mobile devices to engage in practice activities, simulations, and interactive learning experiences can help students develop problem-solving, critical thinking, communication, and digital literacy skills (Dewi, Pahriah, & Purmadi, 2021). Setting learning objectives, evaluating progress, and ruminating on performance are all self-regulated learning practices that can enhance the efficacy of skill development in mobile learning environments (Hanif, 2020).

The relationship between mobile learning and self-regulated learning is a dynamic and complex study area (Palalas & Wark, 2020). Important variables influencing this relationship include mobile learning usage frequency, duration, activity type, self-regulated learning methodologies, intrinsic and extrinsic motivation, amotivation, academic achievement, knowledge retention, and skill development (Chen & Hsu, 2020). Xia et al. (2023) state that additional research is required to understand the underlying mechanisms and dynamics of this relationship and discover effective techniques for encouraging self-regulated learning in mobile learning.

Future Research Agenda

This study has found some variables for future research contributions based on careful literature analysis. A detailed discussion is given below.

Technology Self-efficacy

Technology self-efficacy refers to an individual's confidence in their ability to use and navigate technology effectively (Heo, Bonk, & Doo, 2021). Future research could investigate how self-efficacy in technology influences the connection between mobile learning and self-regulated learning (Chen & Su, 2019). Learners with higher levels of technology self-efficacy are more likely to engage in effective self-regulated learning practices in mobile learning environments, such as setting learning goals, monitoring progress, and reflecting on learning experiences (Chang et al., 2022). This variable would be independent because it is believed to impact mobile and self-regulated learning directly.

Learning Styles

Technology self-efficacy refers to confidence in their ability to effectively use and navigate technology (Heo et al., 2021). Future research could examine how self-efficacy in technology impacts the relationship between mobile learning and self-regulated learning (Chen & Su, 2019). Learners with greater technology self-efficacy are likelier to engage in effective self-regulated learning practices in mobile learning environments, including setting learning objectives, monitoring progress, and reflecting on learning experiences

(Chang et al., 2022). This variable is believed to affect mobile and self-regulated learning directly so that it would be an independent variable.

Learning content relevance

Relevance of learning content refers to the extent to which the content of mobile learning activities is perceived as significant and beneficial to learners' educational or personal goals (Almaiah, Alamri, & Al-Rahmi, 2019). Future research could investigate how the relevance of learning content influences the association between mobile learning and self-regulated learning (Palalas & Wark, 2020). For instance, research may investigate how learners' perceptions of the relevance of mobile learning content affect their engagement in self-regulated learning processes, such as elaboration, organization, and reflection (Jivet et al., 2021). The nature of this variable is believed to serve as a mediator in elucidating the connection between mobile learning and self-regulated learning.

Self-regulated learning strategies

Mekala and Radhakrishnan (2019) define self-regulated learning techniques as learners' cognitive, metacognitive, and motivational processes to organize, monitor, and manage their learning. Future research should investigate the unique self-regulated learning strategies employed by students in mobile learning environments, as well as the effect of these strategies on their self-regulated learning outcomes (Hanif, 2020). For instance, the research could investigate how learners' utilization of self-regulated learning strategies such as goal-setting, self-monitoring, and self-reflection affects their self-regulated learning processes and outcomes in mobile learning settings (Viberg, Khalil, & Baars, 2020). The nature of this variable is believed to serve as a mediator in elucidating the connection between mobile learning and self-regulated learning.

Social Presence in Mobile Learning

Social presence is the experience of being connected and socially present in an online or mobile learning environment (Weidlich & Bastiaens, 2019). Future research may investigate how social presence in mobile learning environments may mediate between mobile learning and self-regulated learning (Wang, Chen, & Zhang, 2021). For instance, the research could investigate how learners' perceptions of social presence, such as interaction with peers, instructor presence, and social feedback, impact their engagement in self-regulated learning strategies, motivation, and outcomes in mobile learning settings (Kilis & Yildirim, 2019). The nature of this variable is believed to serve as a mediator in elucidating the connection between mobile learning and self-regulated learning.

Learner's Prior Experience with Mobile Devices

Learner prior experience with mobile devices refers to the extent to which learners have had previous exposure and experience with using mobile devices for learning or other purposes (Hidayati & Diana, 2019). Future research should investigate how prior learner experience with mobile devices influences the relationship between mobile education and self-regulation (Wang et al., 2020). For instance, the research could investigate how learners' experience with mobile devices affects their engagement in self-regulated learning behaviors in mobile learning environments, such as familiarity with mobile apps, digital

literacy skills, and comfort with mobile devices (Chen & Hsu, 2020). The nature of this variable is that of a moderator, as it is anticipated to interact with mobile learning to influence the outcomes of self-regulated learning.

Cognitive Load of Learners in Mobile Learning

Cognitive load is the mental effort required to comprehend information during learning (Plass & Kalyuga, 2019). Future research could investigate how cognitive load may mediate the relationship between mobile education and self-regulated learning (Curum & Khedo, 2021). For example, the researchers could examine how the cognitive load imposed by mobile learning activities, such as screen size, navigation complexity, and multitasking, influences learners' engagement in self-regulated learning strategies such as attentional control, cognitive monitoring, and metacognitive regulation (Alasmari, 2020). The nature of this variable is believed to serve as a mediator in elucidating the connection between mobile learning and self-regulated learning.

Learner self-efficacy in self-regulated learning

Learner self-efficacy in self-regulated learning refers to learners' perceptions of their capacity to effectively govern their learning processes (Bai & Wang, 2023). Future research could investigate how learners' self-efficacy in self-regulated learning can be used as a dependent variable to examine the relationship between mobile education and self-regulation (Sun & Wang, 2020). For instance, the research could investigate how learners' engagement in mobile learning activities, such as frequency, duration, and variety of activities, influences their self-efficacy beliefs regarding their capacity to self-regulate their learning in mobile learning settings (Liu et al., 2021). This variable's type is a dependent variable because it is thought to be influenced by mobile learning.

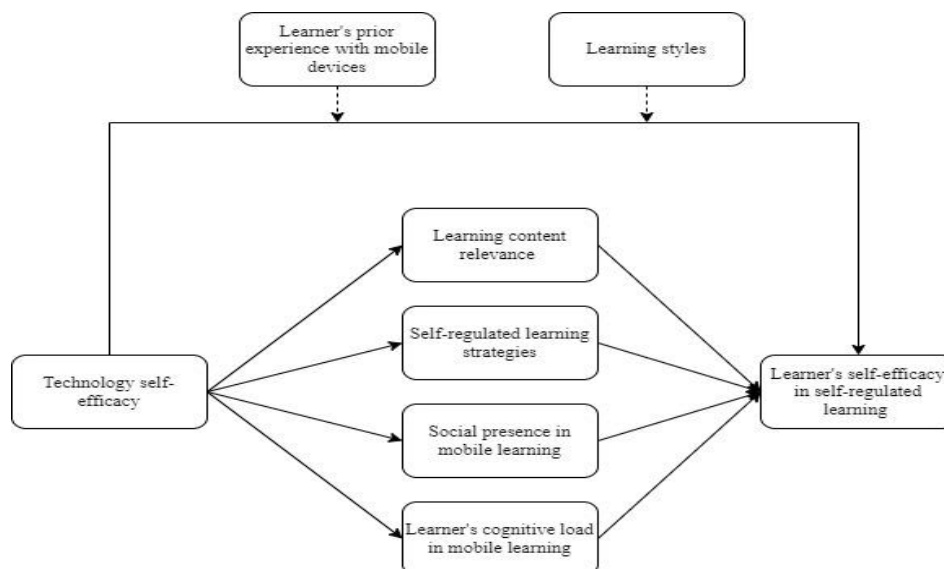


Figure 2: Future Research Proposed Model

Ultimately, these variables could be studied as independent, dependent, mediator, or moderator variables in future research on mobile learning and self-regulated learning to understand their relationship better and identify factors that may influence it (see [Figure 2](#)).

Discussion

The findings of this systematic review provide crucial insights into the relationship between mobile learning and self-regulated learning. Several significant themes and patterns arose from the literature review, shedding light on the current knowledge in this field.

Numerous studies in this review established links between mobile learning and self-regulated learning, including self-monitoring, goal setting, planning, self-evaluation, and self-reflection. With accessibility anywhere and anytime, mobile learning may enable learners to engage in self-regulated, individualized, and adaptable learning processes. For instance, learners may use mobile devices and learning programs to set their learning objectives, monitor their progress, meditate on their learning, and modify their techniques and behaviors.

The review's findings highlight the significance of individual characteristics in determining the relationship between mobile learning and self-regulated learning. For instance, the prevalence and duration of mobile learning use were identified as significant determinants of self-regulated learning outcomes. Learners who utilized mobile devices more frequently and for longer durations displayed higher levels of self-regulated learning behaviors, indicating that the frequency and duration of mobile learning usage may influence the development and application of self-regulated learning strategies.

In addition, it was demonstrated that the type of mobile learning activities significantly impacted self-regulated learning. Various forms of mobile learning activities, such as interactive simulations, collaborative learning, and multimedia presentations, may have variable effects on self-regulated learning, according to the studies included in this review. It has been demonstrated, for instance, that interactive diversity and collaborative learning activities promote more self-regulated learning because they permit active participation, feedback, and social interaction, all of which are essential components of self-supervised learning.

This review reveals the potential mediating roles of other variables, including technological self-efficacy, learning style, academic context, social presence on mobile learning, students' prior experience with mobile devices, cognitive burden, and mobile learning. These variables may interact with mobile learning to influence the outcomes of self-regulated learning, and their participation may vary based on the mobile learning context and circumstances. For instance, learners with greater technological self-efficacy may be more likely to engage in self-regulated learning while using mobile devices, as they are more confident in their ability to use technology to achieve learning objectives. Similarly, prior experience with mobile devices and cognitive burden may influence the efficacy of self-regulated learning strategies employed in mobile learning environments on snow.

"Table 4

Propositions for Future Research

Proposition	Description
Proposition 1	In mobile learning, higher degrees of technology self-efficacy are connected with increased self-regulated learning practices.
Proposition 2	Learning styles moderate the relationship between mobile learning and self-regulated learning, so learners who prefer certain learning styles (e.g., visual, auditory, kinesthetic) may exhibit different self-regulated learning outcomes when engaging in mobile learning activities.
Proposition 3	The relevance of learning content in mobile learning activities acts as a bridge between mobile learning and self-regulated learning outcomes, with learners who view the information as more relevant being more likely to engage in self-regulated learning behaviors.
Proposition 4	Goal setting, self-monitoring, and self-reflection are self-regulated learning strategies that mediate the relationship between mobile learning and academic achievement, with learners who use more self-regulated learning strategies exhibiting higher levels of academic achievement in mobile learning contexts.
Proposition 5	In mobile learning environments, social presence, which includes opportunities for interaction and collaboration with peers and instructors, acts as a mediator between mobile learning and self-regulated learning outcomes, with increased social presence positively impacting self-regulated learning behaviors.
Proposition 6	Prior experience with mobile devices moderates the association between mobile learning and self-regulated learning, with learners with more experience displaying different self-regulated learning behaviors in mobile learning environments.
Proposition 7	In mobile learning, learners' cognitive load, which includes the mental effort required to process information and engage in learning activities, acts as a mediator between mobile learning and self-regulated learning outcomes, with a higher cognitive load harming self-regulated learning behaviors.
Proposition 8	The relationship between mobile learning and self-regulated learning influences learners' self-efficacy in self-regulated learning, with increased self-regulated learning behaviors in mobile learning contexts positively impacting learners' self-efficacy in self-regulated learning.

This policy critic highlights the positive impact of mobile teaching on disciplined teaching practices and concludes (see Table 4) the opportunities available to teachers and the use of mobile teaching, mobile learning use, and mobile use ends education. Its development of power is linked to these rights.

Theoretical and Practical Implications

This study had numerous practical and theoretical implications. When designing mobile learning interventions, it is important to consider learners' unique characteristics and prior experiences. Providing learners with support and resources tailored to their specific requirements, preferences, and prior experiences can increase the efficacy of mobile learning in fostering self-regulated learning. The design process should consider moderating variables such as technology self-efficacy, learning approaches, and prior experience with mobile devices.

The mediating function of learning content relevance and cognitive load should also not be overlooked. Managing cognitive burden by optimizing the design of mobile learning

activities and ensuring that the learning content is relevant and meaningful can positively affect self-regulated learning.

Fusing intrinsic motivation and addressing amotivation is crucial in mobile learning interventions. Educators and instructional designers should seek to cultivate learners' intrinsic motivation through various means, including providing meaningful and engaging mobile learning activities, providing options, and recognizing learners' accomplishments. In addition, addressing amotivation by providing additional support and interventions to learners who lack motivation is crucial for fostering self-regulated learning.

The importance of social presence in mobile learning contexts cannot be overstated. Including opportunities for students to interact with peers, receive feedback, and collaborate can improve self-regulated learning behaviors and outcomes. Mobile learning interventions should acknowledge and incorporate the significance of social presence.

Consideration must also be given to developing students' self-efficacy in self-regulated learning. Teachers and instructional designers should consider strategies for increasing students' self-efficacy in self-regulated learning, such as explicit instruction, modeling, and scaffolding, because self-efficacy influences students' engagement in self-regulated learning behaviors. Conclusion: The findings of this systematic review provide teachers, instructional designers, and planners with valuable implications for enhancing self-directed learning through mobile learning interventions. By considering usage frequency, duration, and types of activities, learners' characteristics and prior experiences, the mediating role of learning content relevance and cognitive load, fostering intrinsic motivation, addressing amotivation, recognizing the role of social presence, and enhancing self-efficacy in self-regulated learning, mobile learning interventions can be designed more effectively to promote self-regulated learning behaviors and improve learning outcomes. Additional research and experimentation are needed in this area to continue advancing mobile education and self-regulated learning.

Limitations and Future Research Recommendations

Based on the findings of this systematic review and the existing literature, there are a variety of potential future research topics that could expand our understanding of the relationship between mobile learning and self-regulated learning. Initially, longitudinal studies may shed insight into the long-term effects of mobile learning on the outcomes of self-regulated learning. By monitoring changes over time, longitudinal study designs can help establish the stability and durability of self-regulated learning behaviors and outcomes.

Second, experimental research can be conducted to investigate the causal relationship between mobile learning and self-directed learning. Experimental designs with a control group may provide stronger evidence for causation and aid in establishing the efficacy of certain mobile learning treatments in promoting self-regulated learning behaviors.

Thirdly, investigating the influence of contextual factors, such as cultural, social, and environmental factors, on the relationship between mobile learning and self-regulated learning could yield important insights. We will understand the complex relationship between mobile learning and self-regulated learning in various contexts if we investigate how contextual factors can limit or mitigate the relationship.

In addition, additional research may be conducted on the design of mobile learning, such as investigating the effect of various mobile learning activities, interfaces, and features on self-directed learning outcomes. This may facilitate the development of effective mobile learning interventions intended to facilitate self-regulated learning processes.

In addition, examining the significance of individual characteristics, such as learning styles, cognitive burden, and self-efficacy, as potential moderators or mediators, in the relationship between mobile learning and self-regulated learning could yield significant insights. Understanding how these individual characteristics may influence the connection could aid in identifying specific elements that may increase or limit the effectiveness of mobile learning in promoting self-regulated learning.

Exploring the potential benefits of integrating mobile learning with other emerging technologies, such as augmented reality, virtual reality, and artificial intelligence, could also result in the development of novel research avenues. Investigating how these technologies can be used to improve self-regulated learning in mobile learning environments could result in the development of innovative educational practices.

Investigating the impact of mobile learning on diverse learner groups, such as those of variable ages, backgrounds, and abilities, could provide a complete understanding of the connection between mobile learning and self-regulated learning. Investigating potential differences in self-regulated learning outcomes across various learner groups may facilitate the development of inclusive mobile learning solutions tailored to learners' specific needs.

Lastly, several intriguing prospective research topics can help us better comprehend the relationship between mobile learning and self-regulated learning. By exploring and analyzing mobile learning designs, researchers can contribute to the growing body of knowledge in this area and incorporate emerging technologies to inform the development of effective mobile learning services that promote self-directed learning.

Conclusion

This systematic review has elucidated the connection between mobile learning and self-directed learning. The findings suggest that mobile learning can positively influence self-regulated learning by allowing students to develop self-assessment, self-guidance, planning, self-monitoring, and self-evaluation. However, the effectiveness of mobile learning to promote self-directed learning is contingent upon several variables, such as the frequency, duration, and type of mobile learning activities, as well as other moderating and mediating variables and students' prior experience with mobile devices.

These findings have crucial implications for teachers, instructional designers, and policymakers in planning and implementing self-regulated classroom interventions for mobile devices. Consideration of the frequency and duration of mobile learning usage, as well as the types of mobile learning activities, may, for instance, increase the efficacy of mobile learning in developing self-regulated learning behaviors among students. Recognizing the mediating and moderating functions of other variables may also aid in customizing mobile learning interventions to the characteristics and contexts of individual learners, thereby optimizing their influence on self-regulated learning outcomes.

Important limitations of this systematic review must be highlighted, including the possibility of publication bias and the low quality of the included research. Future research may surmount these limitations by utilizing a broader range of literature sources, employing various research strategies, and conducting exhaustive quality assessments. Potentially, a longitudinal study could shed light on the long-term effects of mobile learning on self-regulated learning behaviors and outcomes. Additionally, as mobile technologies and the field of mobile learning evolve, more research is required to investigate the potential of emergent technologies such as augmented reality, virtual reality, and artificial intelligence to promote self-directed learning in a mobile learning environment.

This systematic review advances knowledge of the relationship between mobile learning and self-regulated learning by highlighting the significance of multiple factors in determining this relationship in the snow. The findings provide a foundation for future research and have practical implications for educators and policymakers who look to harness the potential of mobile learning to promote self-directed learning among students in education under the given conditions.

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