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Self-Regulated Learning in the Digital Age: A Systematic Review of Strategies, Technologies, Benefits, and Challenges

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Abstract

When students enter higher education, self-regulated learning (SRL) involving goal setting, planning, monitoring, and reflection is crucial for academic success. This study systematically reviews SRL strategies, supporting technologies, and their impacts, especially with the shift to online learning due to the COVID-19 pandemic. Following Kitchenham's guidelines, 121 articles from ScienceDirect and Scopus were reviewed. Key SRL strategies include goal setting, cognitive and metacognitive processes, time management, self-reflection, help-seeking, and monitoring. Technologies such as learning management systems (LMS), massive open online courses (MOOCs), artificial intelligence (AI), collaborative platforms, and learning analytics support SRL by providing personalized feedback and facilitating autonomous learning. Benefits include improved performance, motivation, and engagement, while challenges involve limited access to digital resources, technical issues, resistance to change, and inadequate instructor training. Addressing these barriers is essential for optimizing SRL implementation, guiding future research and educational practice.

Keywords: self-regulated learning strategies, self-directed learning strategies, educational technologies, systematic literature review

Introduction

When students enter higher education, accountability in thoughts and actions is crucial for realizing potential and achieving academic success (Latipah et al., 2021). Planning learning activities, collaborating, working in teams, and conveying ideas through physical and digital media enhance academic achievement (Tadesse et al., 2022). These skills are integral components of self-regulated learning (SRL), where students independently set goals, reflect on their progress, and evaluate their learning. SRL is not only critical for academic success but also fosters lifelong learning (Tekkol & Demirel, 2018) and prepares students for future challenges, such as competitiveness in the job market (Latipah et al., 2021; Muwonge et al., 2020; Nguyen & Zarra-Nezhad, 2023).

Technological advancements have significantly transformed the landscape of education. Traditional learning is now often digital, accelerated by the COVID-19 pandemic, which required social distancing and remote learning (Anthonysamy et al., 2021; Nguyen & Zarra-Nezhad, 2023). Online learning reduces social interactions, especially in instruction and feedback, necessitating strong SRL skills to maintain motivation and prevent dropout (Domínguez et al., 2021).

While previous research has identified various SRL strategies, supporting technologies, benefits, and implementation challenges (Araka et al., 2020; Heikkinen et al., 2023; Su et al., 2023), these aspects have typically been examined separately, often lacking a unified framework. Moreover, existing literature reviews tend to focus on specific components of SRL or on particular educational settings, such as traditional classrooms or fully online environments, without providing a comprehensive overview that addresses the integration of SRL strategies, technologies, and challenges in hybrid and evolving digital learning contexts. This study distinguishes itself from prior reviews by offering a holistic synthesis that not only covers all four aspects of SRL but also highlights their interdependencies within diverse digital learning environments.

By addressing these gaps, this study aims to advance the understanding of SRL by systematically reviewing and synthesizing existing research on SRL strategies, supporting technologies, benefits, and challenges in digital education. This integrated approach provides a more comprehensive framework for educators and policymakers to implement effective SRL practices tailored to the nuances of digital learning. The research questions are as follows:

1. What are the strategies in self-regulated learning?

2. What information technology tools have been used to support self-regulated learning (SRL) strategies in educational settings?

3. What are the benefits of IT-supported SRL strategies?

4. What are the barriers to implementing IT-supported SRL strategies in educational institutions?

The findings will help students effectively use SRL strategies and technologies, understanding their benefits and challenges.

Self-Regulated Learning

Self-regulated learning (SRL) is an active, constructive process where learners set goals and regulate their cognition, motivation, and behavior to achieve these goals (Turan et al., 2022). It involves setting goals, devising strategies, and monitoring effectiveness (Kesuma et al., 2020), with dimensions such as goal setting, help-seeking, self-learning, managing the environment, and effort regulation (Amiruddin et al., 2023). Learners autonomously set their own goals, manage time, select strategies, and evaluate progress (Karrenbauer et al., 2023; Saiyad et al., 2020). Comprehensive models by Winne and Hadwin (1998) include stages such as task definition, planning, enactment, and evaluation (Liang et al., 2023; Pintrich, 2000). SRL includes monitoring processes such as goal orientation, environment structuring, time management, task strategies, help-seeking, and self-evaluation (Hidayatullah & Csíkos, 2023), crucial for online learning success (Yeh et al., 2019). Supported by cognitive and metacognitive processes (Brusilovsky et al., 2015; Cook et al., 2015; Kay et al., 2022; Kay & Lum, 2005; Panadero, 2017; Tise et al., 2023; Upton & Kay, 2009; Zimmerman, 2008), effective SRL requires accurate metacognition (Cervin-Ellqvist et al., 2021; Wild & Neef, 2023). Promoting learner autonomy involves empowering students to set goals, make decisions, and monitor progress (Kay et al., 2022; Schunk & Ertmer, 2000; Zimmerman & Moylan, 2009). The cyclical interaction of cognitive and metacognitive activities fosters lifelong learning and professional skills development (Biggs, 1999; Kay et al., 2022; Wong et al., 2019).

Previous Studies

Several previous studies have identified various strategies, supporting technologies, benefits, and challenges related to the implementation of SRL, using systematic literature reviews, scoping reviews, and meta-analyses. Key strategies identified include cognitive and metacognitive strategies, affective strategies, motivational regulation strategies, behavioral and contextual regulation strategies, time management, effort regulation, and planning and goal setting (Ballouk et al., 2022; Doo et al., 2023; Edisherashvili et al., 2022; Heikkinen et al., 2023; Lee et al., 2019; Su et al., 2023; Xu et al., 2023). Additionally, tools such as the Learning Tracker prototype, learning analytics, the Online Self-Regulated Learning Questionnaire, and the Motivated Strategies for Learning Questionnaire have been highlighted as supporting the implementation of SRL (Araka et al., 2020; Heikkinen et al., 2023; Lee et al., 2019). The benefits of SRL implementation noted in previous research include enhanced academic success, better engagement with course materials, improved study habits, and sustained motivation and autonomy (Ballouk et al., 2022; Cheng et al., 2023; Doo et al., 2023; Heikkinen et al., 2023; Su et al., 2023; Xu et al., 2023). Despite these benefits, challenges remain, particularly in measuring students' ability to apply SRL in e-learning environments (Araka et al., 2020). Table 1 provides a summary of these previous research articles, showing their methods, magnitude, and main focus.

Table 1

Summary of Previous Reviews and Analyses on Self-Regulated Learning

Review	Method	Studies reviewed, *n*	Focus
Su et al. (2023)	Systematic review	20	SRL strategies and SRL benefits
Lee et al. (2019)	Systematic review	21	SRL strategies and SRL supporting technologies
Heikkinen et al. (2023)	Systematic review	56	SRL supporting tools and SRL benefits
Edisherashvili et al. (2022)	Systematic review	38	SRL strategies
Xu et al. (2023)	Scoping review	163	SRL strategies and SRL benefits
Doo et al. (2023)	Meta-analysis	14	SRL strategies and SRL benefits
Cheng et al. (2023)	Meta-analysis	27	SRL benefits
Araka et al. (2020)	Systematic review	30	SRL supporting technologies and SRL challenges
Ballouk et al. (2022)	Scoping review	44	SRL strategies and SRL benefits

From Table 1, it can be concluded that studies have identified four aspects related to the implementation of SRL: (a) strategies, (b) supporting technologies, (c) benefits, and (d) challenges. However, these four aspects have been individually examined in separate studies. This research has synthesized all four aspects into a single study.

Method

Research Design

This systematic literature review followed Kitchenham's guidelines, comprising three stages: (a) planning, (b) conducting the review, and (c) reporting (Kitchenham, 2004; Kitchenham, et al., 2009; Kitchenham et al., 2015). In the planning stage, a comprehensive research protocol was developed, which defined the research questions, search strategy, and inclusion, exclusion, and quality criteria, as illustrated in Figure 1.

Data Analysis

The inclusion and exclusion criteria were meticulously applied to ensure that only high-quality and relevant articles were selected for the review. This rigorous selection process was designed to maintain the integrity and relevance of the review. For the literature search, ScienceDirect and Scopus databases were selected due to their extensive coverage of peer-reviewed journals across various disciplines relevant to the study and their strong reputation for high-impact publications. The keywords used for the literature search, along with their alternatives, are also presented in Figure 1. These keywords were chosen to ensure a well-defined approach to capturing relevant studies. Due to the Boolean operator limit in ScienceDirect (maximum of

eight), two separate search strings were used to ensure that the search was both exhaustive and precise, maximizing the retrieval of relevant articles while minimizing irrelevant results.

Figure 1

Research Protocol

Research Question		• What are the strategies in self-regulated learning (SRL)? • What information technology tools have been used to support SRL strategies in educational settings? • What are the benefits of IT-supported SRL strategies? • What are the barriers to implementing IT-supported SRL strategies in educational institutions?	
Search Strategy	Digital Libraries	ScienceDirect	https://www.sciencedirect.com/
		Scopus	https://www.scopus.com/
	Search Terms	Keywords	Alternatives
		SRL	SRL, Self-directed learning, SDL
		Strategies	Methods, Techniques
		Technologies	IT, information technology
		Benefits	Advantages
		Challenges	Barriers
	Search Strings	ScienceDirect	((Self-regualted learning) OR SRL) AND (Strategies OR Methods OR Techniques) AND (IT OR (Information Technologies)) AND (Benefits) AND (Challenges)
		Scopus	((Self-regualted AND learning) OR SRL OR (Self-directed AND learning) OR SDL) AND (Strategies OR Methods OR Techniques) AND (Technologies OR IT OR (Information AND Technologies)) AND (Benefits OR Advantages) AND (Challenges OR Barriers)
Inclusion Criteria		• Full-text publications • Published between 2019 and 2024 • Written in English • Available for access • Identify SRL strategies • Include SRL support technologies • Discuss the benefits and challenges of SRL implementation	
Exclusion Criteria		• • Grey literature (theses, unpublished, and incomplete works), books, editorials • • Educational technology studies not focused on SRL implementation • SRL research from perspectives other than students	
Quality Criteria		• Theoretical basis • Data gathering, analysis, and presentation • Reference use • Research objectives • Credibility and stated conclusions • Contribution to knowledge or understanding	

Selecting Articles for Inclusion

After the research protocol was developed, the next step was to initiate the search and collection of journal articles. Table 2 summarizes the stages of the search and collection process, along with the number of articles at each stage. To further enrich the review, a snowballing technique was applied to the selected articles after a thorough examination of their abstracts and findings. A total of 121 articles were included after all stages were completed.

Validity and Reliability

To minimize bias and maintain rigor, each article was evaluated against the inclusion and exclusion criteria by two independent reviewers. This approach helped ensure that the selection process was both valid and reliable, reducing the likelihood of subjective bias in the study selection. Any discrepancies between reviewers were discussed and resolved through consensus, further enhancing the reliability of the selection process.

Table 2

Number of Articles Included After Each Stage of the Search and Collection Process

Source	Stage			
	Preliminary search	Post inclusion	Post exclusion	Post screening of abstract and findings
ScienceDirect	1,946	500	120	34
Scopus	101	70	50	39
Snowballing				48
Total	2,047	570	170	121

Findings and Discussion

Figure 2 provides a summary of the articles used for analysis, categorized by year of publication and database. The data reveal that 2023 had the highest number of publications, totaling 36 research articles, with 15 articles from ScienceDirect, 14 from Scopus, and 7 obtained through the snowballing process. Conversely, 2024 had the lowest number of publications, with a total of 6 articles, equally distributed between ScienceDirect and Scopus, each contributing 3 articles. However, as the year 2024 is still in progress, this is expected to change.

Figure 2

Number of Publications per Year by Database
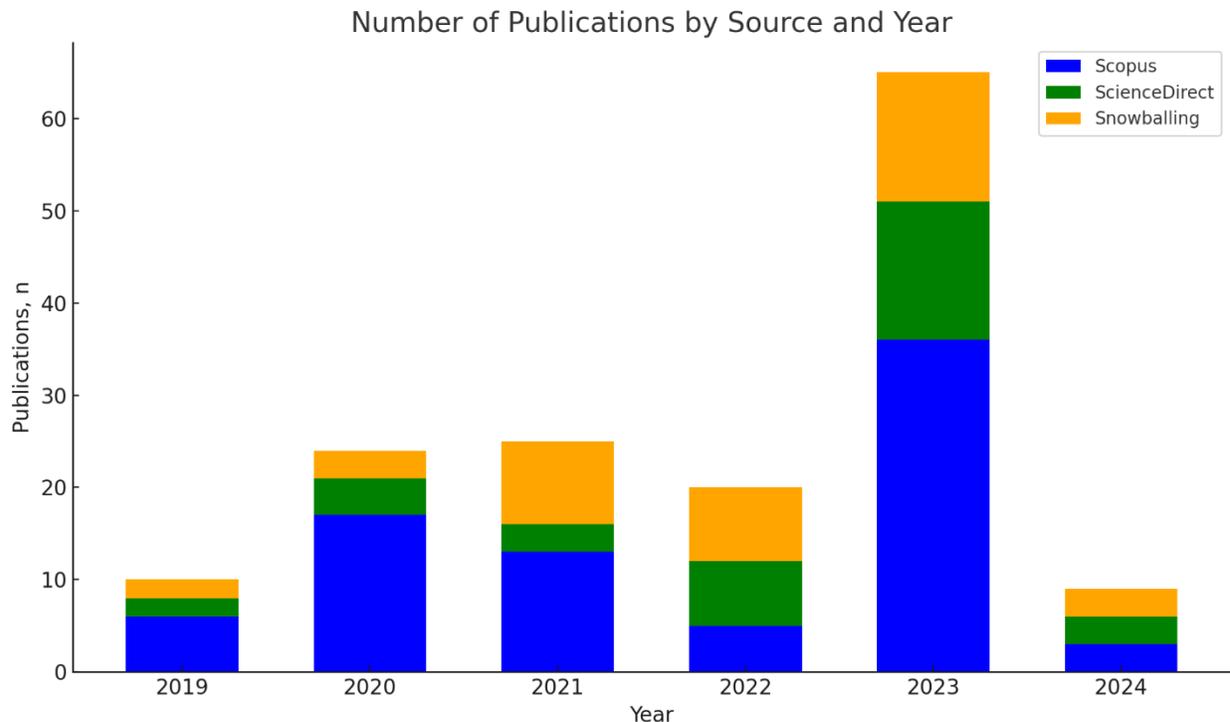
The following section discusses the identified strategies, technological support, benefits, and challenges of self-regulated learning (SRL).

Self-Regulated Learning Strategies

In SRL, goal setting is crucial for organizing thoughts, emotions, and actions to achieve objectives, including goal clarity, planning, and behavior adaptation based on feedback (Mapuya, 2022; Omar et al., 2023; Zimmerman & Schunk, 2011). Pintrich (1999) identified three goal orientations: mastery, performance, and comparison, where mastery goals enhance SRL strategies and learning, while performance and comparison goals may have negative effects (Jivet et al., 2020). Effective goal setting involves specific, measurable objectives, timelines, continuous assessment, and adjustments (Chen, 2023; Funa et al., 2023; Kay et al., 2022; Kesuma et al., 2020).

Cognitive and metacognitive processes are central to SRL, enabling learners to monitor, control, and adapt their cognitive activities (Cervin-Ellqvist et al., 2021; Fleur et al., 2023; Kesuma et al., 2020). Metacognition involves higher-order processes such as self-checking and evaluating cognitive activities (Cervin-Ellqvist et al., 2021; Mapuya, 2022; Yeh et al., 2019). Cognitive strategies such as rehearsal, elaboration, organization, and critical thinking aid in planning, monitoring, and adjusting learning processes (Kay et al., 2022; Tise et al., 2023).

Time management in SRL involves allocating study time, monitoring progress, and maintaining motivation, especially in online environments (Jivet et al., 2020; Osakwe et al., 2023; Wong et al., 2021). Effective time management includes setting goals, efficient time allocation, monitoring progress, and adjusting schedules (Apridayani et al., 2023; Bećirović et al., 2022; Huber & Helm, 2020; Oinas et al., 2022; Yeh et al., 2019). Time management interventions reduce anxiety and improve academic balance (Apridayani et al., 2023; Huber & Helm, 2020; Oinas et al., 2022; Osakwe et al., 2023).

Self-reflection and evaluation are vital for reviewing performance, assessing progress, identifying strengths and weaknesses, and adjusting strategies (Kesuma et al., 2020; Khalid et al., 2024; Tise et al., 2023; Xu et al., 2022). Reflective writing and technological tools support these processes, allowing students to track learning progression and make adjustments (Kay et al., 2022).

Help-seeking in SRL involves seeking assistance or resources when facing learning challenges, fostering self-awareness and adaptive strategies (Chen, 2023; Hidayatullah & Csíkos, 2023). Effective help-seeking requires knowing when to seek help, whom to ask, and how to evaluate the received assistance (Xu et al., 2022). Self-regulated instruction includes seeking assistance from peers, parents, or instructors (Ismail et al., 2023). AI technologies and open learner models (OLMs) support help-seeking by providing personalized assistance and performance metrics (Bodily & Verbert, 2017).

Monitoring in SRL involves continuously tracking progress, evaluating strategies, and making necessary adjustments to achieve learning goals. Portfolio assessments further support independent monitoring and improvement of academic performance, promoting learner autonomy (Ismail et al., 2023). Technological tools like OLMs facilitate monitoring by displaying mastery levels and performance metrics (Kay et al., 2022).

Task management in SRL involves organizing and planning activities to achieve learning goals, using both cognitive and metacognitive strategies (Funa et al., 2023). Effective task strategies predict personal course goals and learning gains, with perceived autonomy enhancing task management and problem-solving abilities (Hidayatullah & Csíkos, 2023). Table 3 presents various SRL strategies identified in the literature, along with supporting source references.

Table 3

Self-Regulated Learning Strategies and Source References

Strategy	References
Goal setting	Alotumi, 2021; Al-Shaye, 2021; Chen, 2023; Darvishi et al., 2024; Funa et al., 2023; Habók et al., 2024; Huang et al., 2021; Ingkavara et al., 2022; Jeon & Lee, 2023; Jivet et al., 2020; Kay et al., 2022; Kesuma et al., 2020; Lukes et al., 2020; Mapuya, 2022; Nufus et al., 2024; Omar et al., 2023; Osakwe et al., 2023; Reyes-Millán et al., 2023; Su et al., 2023; Tao et al., 2023; Tran & Phan Tran, 2021; Zarestky et al., 2022

Cognitive and metacognitive	Anthonysamy et al., 2021; Cervin-Ellqvist et al., 2021; Fleur et al., 2023; Hidayatullah & Csíkos, 2023; Karrenbauer et al., 2023; Kay et al., 2022; Kesuma et al., 2020; Khalid et al., 2024; Nguyen & Zarra-Nezhad, 2023; Latipah et al., 2021; Liang et al., 2023; Lukes et al., 2020; Mapuya, 2022; Muwonge et al., 2020; Oinas et al., 2022; Omar et al., 2023; Tise et al., 2023; Wild & Neef, 2023; Yeh et al., 2019
Time management	Apridayani et al., 2023; Bećirović et al., 2022; Darvishi et al., 2024; Fleur et al., 2023; Hidayatullah & Csíkos, 2023; Jivet et al., 2020; Khalid et al., 2024; Kong & Lin, 2023; Mapuya, 2022; Oinas et al., 2022; Omar et al., 2023; Osakwe et al., 2023; Patiño-Toro et al., 2023; Reyes-Millán et al., 2023; Su et al., 2023; Wong et al., 2021; Yavuzalp & Bahcivan, 2021
Self-reflection and evaluation	Imhof et al., 2024; Ingkavara et al., 2022; Ismail et al., 2023; Kay et al., 2022; Kesuma et al., 2020; Khalid et al., 2024; Tise et al., 2023; Wong et al., 2021; Xu et al., 2022; Yeh et al., 2019; Zhou et al., 2021
Help-seeking	Alhalafawy & Zaki, 2022; Bacher-Hicks et al., 2021; Briones et al., 2023; Chen, 2023; Darvishi et al., 2024; Hidayatullah & Csíkos, 2023; Ismail et al., 2023; Kay et al., 2022; Tadesse et al., 2022; Xu et al., 2022
Monitoring	Huang et al., 2021; Imhof et al., 2024; Ingkavara et al., 2022; Ismail et al., 2023; Karrenbauer et al., 2023; Kay et al., 2022; Martin et al., 2022; Su et al., 2023
Task management	Funa et al., 2023; Hidayatullah & Csíkos, 2023; Liang et al., 2023; Matsuyama et al., 2019; Wild & Neef, 2023; Yeh et al., 2019; Zhou et al., 2021

Self-Regulated Learning Supporting Technologies

Learning management systems (LMS) are essential for accessing course materials, interacting with peers and instructors, and managing learning activities (Abduvakhidov et al., 2021; Reyes-Millán et al., 2023). These systems play a significant role in facilitating self-regulated learning (SRL) by organizing educational resources, tracking learner progress, and implementing strategies that promote self-regulation (Kong & Lin, 2023). Additionally, a LMS can be customized to provide personalized learning experiences that align with individual learner preferences, further enhancing the effectiveness of SRL (Han et al., 2021; Khalid et al., 2024).

Similarly, massive open online courses (MOOCs) contribute to SRL by allowing learners to manage their learning processes independently, set goals, and monitor progress (Wong et al., 2021). However, while

MOOCs offer flexibility and broad access to educational resources, they are often challenged by high dropout rates, which can be mitigated through better engagement strategies (Mehrabi et al., 2020; White et al., 2020). Learning analytics dashboards (LADs) within MOOCs offer valuable feedback on study habits and progress, enhancing SRL by helping learners adjust their strategies as needed (Fleur et al., 2023).

Artificial intelligence (AI) further enhances SRL by providing personalized learning paths and real-time support (Ingkavara et al., 2022; Markauskaite et al., 2022). AI tools such as ChatGPT provide tailored assistance, feedback, and scaffolding that enhance learner engagement and self-efficacy (Dai et al., 2023; Darvishi et al., 2024; Jeon & Lee, 2023; Milano et al., 2023). These tools are particularly effective in supporting goal setting, time management, and help-seeking behaviors through dynamic feedback and assessments (Darvishi et al., 2024; Deeva et al., 2021).

In addition to individual learning tools, collaborative platforms are essential for supporting SRL by fostering interaction and collaboration among students and instructors (Núñez et al., 2019, 2023). These platforms facilitate group discussions, resource sharing, and collaborative projects, promoting active engagement and peer support, which are critical components of effective SRL (Fructuoso et al., 2023; Liang et al., 2023). Tools such as Blackboard, Skype, or discussion boards promote active engagement and peer support (Briones et al., 2023; Mapuya, 2022).

Mobile learning (m-learning) enhances SRL by providing accessible and interactive learning resources through mobile applications (Khalid et al., 2024). The use of mobile devices has been shown to improve both self-regulation and learning outcomes (Nikolopoulou, 2023). Additionally, mobile applications support engagement, flexibility, and collaboration in both classroom and no-classroom settings (Elkot & Ali, 2020; Reyes-Millán et al., 2023). Therefore, it is critical for online course designers to ensure mobile accessibility to effectively support SRL (Briones et al., 2023).

Learning analytics (LA) involves the collection and analysis of learner data to optimize educational outcomes (Baek & Doleck, 2023; Fleur et al., 2023; Tao et al., 2023; Zheng et al., 2021). LA tools provide visual data representations, enabling students to assess their performance and engage in self-reflection (Jivet et al., 2020). By offering insights into progress and areas for improvement, these tools effectively support self-regulated learning (Ingkavara et al., 2022). LA dashboards help learners set goals, self-monitor, and self-evaluate, which enhances motivation and participation (Fleur et al., 2023; Jivet et al., 2020). Effective LA interventions largely depend on the design of dashboards that facilitate meaningful data interpretation. Additionally, while LA can support help-seeking behaviors by providing progress insights, dashboard design must account for how learners interact with these tools to optimize SRL support (Jivet et al., 2020).

Task strategies, such as digital note-taking, also play an essential role in enhancing learning gains and SRL (Mapuya, 2022; Su et al., 2023). Apps that track goals or facilitate digital journaling help in self-reflection and evaluation, supporting continuous learning (Anthonysamy et al., 2021; Zarestky et al., 2022). Teacher observation and personalized feedback further support these processes (Ismail et al., 2023).

Technology-based educational tools promote self-regulatory behaviors through features such as virtual tutors, instant feedback, and adaptive technology (Khalid et al., 2024). Interactive tools such as OLMs

provide personalized learning experiences and encourage learner autonomy (Kay et al., 2022). Reading quizzes, screencast feedback, digital platform-based gamification (DPBG) and similar tools support SRL by enhancing cognitive and metacognitive processes (Alhalafawy & Zaki, 2022; Inan-Karagul & Seker, 2021; Karrenbauer et al., 2023; Lukes et al., 2020). Platforms such as Microsoft Forms, Mentimeter, and Poll Everywhere also aid formative assessment and engagement (Fructuoso et al., 2023). Moreover, intelligent learning systems facilitate personalized learning by incorporating learner preferences and individual data (Han et al., 2021; Ingkavara et al., 2022; Rodríguez et al., 2022; Troussas et al., 2020; Xie et al., 2019).

Digital resources and repositories are valuable for SRL, providing vast and accessible materials that support personalized learning and autonomy (Tise et al., 2023). These resources play a key role in flipped classroom instruction by making learning materials readily available to students (Raviv et al., 2023). By expanding access to materials and tools, digital resources further support SRL and personalized learning (Tise et al., 2023). Additionally, they facilitate cultural exchanges and promote digital literacy among mentors, enriching the learning experience (Abdullah et al., 2022; Carvalho & Santos, 2022; Chauncey & McKenna, 2023; Kay et al., 2022; Riatun & Alvin, 2023).

Finally, video conferencing tools enable synchronous communication and collaborative learning, enhancing SRL (Khalid et al., 2024). Tools such as Google Meet and Zoom facilitate interactions between teachers and students, promoting engagement and participation in virtual settings (Al-Shaye, 2021; Briones et al., 2023; Mapuya, 2022). These tools also support active engagement and collaboration among virtual students (Briones et al., 2023). Table 4 presents the various technologies supporting SRL identified in the literature, along with supporting source references.

Table 4

Self-Regulated Learning Support Technologies and Source References

Support technology	References
Learning management system	Abduvakhidov et al., 2021; Fructuoso et al., 2023; Han et al., 2021; Ingkavara et al., 2022; Karrenbauer et al., 2023; Khalid et al., 2024; Kong & Lin, 2023; Omar et al., 2023; Reyes-Millán et al., 2023; Rodríguez et al., 2022; Tise et al., 2023; Troussas et al., 2020; Zarestky et al., 2022
MOOC	Fleur et al., 2023; Günther, 2021; Lambert, 2020; Lee et al., 2019; Lu, 2021; Mehrabi et al., 2020; Patiño-Toro et al., 2023; Paudyal et al., 2019; Khan et al., 2020; Rodríguez et al., 2022; White et al., 2020; Wong et al., 2019; Wong et al., 2021
AI and chatbot	Alqahtani et al., 2023; Chauncey & McKenna, 2023; Dai et al., 2023; Darvishi et al., 2024; Deeva et al., 2021; HolonIQ, 2022; Ingkavara et al., 2022; Jeon & Lee, 2023; Markauskaite et al., 2022; Milano et al., 2023; Yan et al., 2023

Collaborative platforms	Briones et al., 2023; Fructuoso et al., 2023; Khalid et al., 2024; Liang et al., 2023; Mapuya, 2022; Núñez et al., 2019, 2023
Mobile educational application	Anthonysamy et al., 2021; Briones et al., 2023; Elkot & Ali, 2020; Khalid et al., 2024; Nikolopoulou, 2023; Omar et al., 2023; Reyes-Millán et al., 2023
Learning analytics and dashboards	Baek & Doleck, 2023; Fleur et al., 2023; Günther, 2021; Ingkavara et al., 2022; Jivet et al., 2020; Tao et al., 2023; Zheng et al., 2021
Digital note-taking	Anthonysamy et al., 2021; Ismail et al., 2023; Mapuya, 2022; Su et al., 2023; Zarestky et al., 2022
Learning interactivity tools	Alhalafawy & Zaki, 2022; Fructuoso et al., 2023; Han et al., 2021; Inan-Karagul & Seker, 2021; Ingkavara et al., 2022; Karrenbauer et al., 2023; Kay et al., 2022; Khalid et al., 2024; Kong & Lin, 2023; Lukes et al., 2020; Rodríguez et al., 2022
Digital resources and repositories	Abdullah et al., 2022; Bravo-Agapito et al., 2021; Carvalho & Santos, 2022; Chauncey & McKenna, 2023; Kay et al., 2022; Kim et al., 2022; Núñez et al., 2023; Raviv et al., 2023; Tise et al., 2023
Video conferencing tools	Al-Shaye, 2021; Briones et al., 2023; Khalid et al., 2024; Mapuya, 2022

Self-Regulated Learning Benefits

SRL is essential for academic success and is closely linked to higher achievements (Heirweg et al., 2020; Oinas et al., 2022; van Alten et al., 2020). SRL involves independent planning, managing, and assessing learning to achieve goals, significantly boosting performance, especially in online learning (Hidayatullah & Csíkos, 2023; Yeh et al., 2019). While explicit reading strategies combined with SRL have been shown to enhance performance, the absence of SRL strategies leads to significant challenges for students, including reduced engagement and higher dropout rates (Irvine et al., 2021; ter Beek et al., 2019). High SRL skills predict better academic performance and online learning success (Hidayatullah & Csíkos, 2023; Lee et al., 2021). Personal involvement and motivation are key for success (Apridayani et al., 2023). SRL is crucial not only for understanding and improving performance but also for predicting engagement and performance in online courses and impacting long-term retention and skills (Guo et al., 2022; Imhof et al., 2024; Martin et al., 2022).

Engagement in learning involves interacting with content to achieve goals. Learners tend to prefer active environments and collaboration (Bećirović et al., 2022; Lin & Dai, 2022; Matsuyama et al., 2019). Although self-reflection and feedback tools have been shown to enhance engagement and motivation, their impact can be limited if not properly aligned with the learning objectives and student needs (Fructuoso et al., 2023; Su et al., 2023). SRL is vital for engagement and course completion, particularly in online learning environments (Amiruddin et al., 2023; Kesuma et al., 2020; Wong et al., 2021). SRL strategies help

maintain motivation by fostering supportive learning behaviors, especially in online contexts (Alotumi, 2021; Li et al., 2023; Omar et al., 2023). Student-centered approaches in learning systems support SRL, fostering skills for language learning and 21st-century skills (Omar et al., 2023). Moreover, engaging learning environments play a key role in boosting motivation and self-regulation (Khalid et al., 2024), and transitioning to a learner-centered model significantly increases both engagement and SRL (Matsuyama et al., 2019).

Autonomous learners are accountable for their learning decisions and responsible for their education (Ismail et al., 2023). Autonomy enhances self-organization and involves deciding one's learning plan and choosing mentors (Matsuyama et al., 2019; Zhou et al., 2021). Authentic assessments promote autonomy by making learners responsible for their education (Ismail et al., 2023). Self-regulated learning (SRL) enhances interest and engagement through autonomy, fostering academic ownership via technology (Khalid et al., 2024; Nikolopoulou, 2023). SRL involves goal setting, strategy planning, and progress monitoring (Ingkavara et al., 2022; Karrenbauer et al., 2023). Online learning environments support needs like competence and relatedness, enhancing motivation and autonomy (Xu et al., 2022). Gamification and digital applications engage students through autonomous learning (Alhalafawy & Zaki, 2022; Bećirović et al., 2022). Mentor support and reflection on learning experiences further enhance autonomy (Carvalho & Santos, 2022; Matsuyama et al., 2019). Overall, SRL empowers learners to control their learning, increasing motivation, engagement, and independence (Omar et al., 2023; Su et al., 2023).

Motivation is key in the learner-centered approach. SRL learners with metacognitive abilities are highly motivated and perform better academically (Kesuma et al., 2020; Muwonge et al., 2020). Motivation and self-efficacy are closely linked to engagement and SRL behaviors; however, fostering these traits requires a nuanced understanding of each student's individual goals and contexts (Wong et al., 2021). Individual goals and motivation impact SRL strategies, with perceived autonomy linked to online SRL and greater motivation (Hidayatullah & Csíkos, 2023; Kong & Lin, 2023). SRL combines academic learning with self-control, leading to improved motivation (Nufus et al., 2024). Mobile applications supporting SRL strategies have also been shown to increase motivation (Elkot & Ali, 2020). Overall, motivation plays a crucial role in fostering both engagement and SRL behaviors.

Self-efficacy, defined as learners' beliefs in their ability to succeed, is crucial for academic success in SRL. High self-efficacy leads to persistence, effective learning behaviors, and personal goal achievement in online environments, enhancing confidence and resilience (Wong et al., 2021). Strategies promoting self-efficacy enhance belief in abilities, impacting academic success (Khalid et al., 2024). Emphasizing self-observation and self-judgment fosters academic self-efficacy, improving achievement (Kesuma et al., 2020). However, overemphasis on self-judgment without adequate feedback can lead to negative self-assessment and reduced motivation, highlighting the need for balanced instructional strategies. High self-efficacy learners display persistence, task interest, and effective emotion management, contributing to frequent SRL strategy use (Lee et al., 2021; Martin et al., 2022). Building confidence in executing strategies and achieving outcomes enhances motivation and persistence (Tise et al., 2023). Positive reinforcement and task value reinforce this confidence, enhancing resilience and performance (Wong et al., 2021).

Personalized learning experiences, achieved through individual goal setting and tailored strategies, facilitate the shift toward a learner-centered model (Matsuyama et al., 2019; Zhou et al., 2020).

Nonetheless, personalization must be carefully calibrated to avoid information overload or misalignment with broader curricular objectives. Portfolio assessments reflect progress and areas for improvement, while authentic assessments develop skills through real-world situations (Ismail et al., 2023). Personalized SRL systems enhance learning through goal setting and tailored paths (Ingkavara et al., 2022). Personalized advice on SRL strategies fosters learning (Lim et al., 2023). Personalized feedback helps learners understand strengths and areas for improvement, promoting SRL (Ingkavara et al., 2022; Khalid et al., 2024; Osakwe et al., 2023). Digital teaching strategies ensure personalized learning through structured experiences and reflective practices (Al-Shaye, 2021), while online courses allow self-paced study, enhancing SRL and overall competence (Raviv et al., 2023).

Feedback ranges from basic formats, including grades, to more comprehensive methods such as comments and rubrics (Lukes et al., 2020). A learner-centered approach requires personalized feedback to meet diverse needs (Matsuyama et al., 2019). Instructors must provide timely support and feedback, especially to students struggling with reflection, to promote in-depth reflection and effective goal-setting (Li et al., 2023). Individualized, narrative feedback from mentors significantly promotes professional identity formation (PIF; Matsuyama et al., 2019). Personalized training encourages strategy adoption (Inan-Karagul & Seker, 2021), and students use feedback to manage time and resources efficiently (Su et al., 2023). Table 5 presents the various benefits of implementing SRL identified in the literature, along with supporting source references.

Table 5

Self-Regulated Learning Benefits and Source References

Benefit	References
Support academic achievements	Al-Shaye, 2021; Apridayani et al., 2023; Bećirović et al., 2022; Chen & Li, 2021; Elkot & Ali, 2020; Fructuoso et al., 2023; Guo et al., 2022; Heirweg et al., 2020; Hidayatullah & Csíkos, 2023; Imhof et al., 2024; Irvine et al., 2021; Karrenbauer et al., 2023; Lee et al., 2021; Liang et al., 2023; Lukes et al., 2020; Martin et al., 2022; Núñez et al., 2023; Oinas et al., 2022; Reparaz et al., 2020; Su et al., 2023; Tao et al., 2023; ter Beek et al., 2019; van Alten et al., 2020; Wang et al., 2019; Yeh et al., 2019
Increase engagement	Alotumi, 2021; Al-Shaye, 2021; Amiruddin et al., 2023; Bećirović et al., 2022; Briones et al., 2023; Elkot & Ali, 2020; Fructuoso et al., 2023; Guo et al., 2022; Imhof et al., 2024; Inan-Karagul & Seker, 2021; Ismail et al., 2023; Kesuma et al., 2020; Khalid et al., 2024; Li et al., 2023; Lin & Dai, 2022; Matsuyama et al., 2019; Nikolopoulou, 2023; Omar et al., 2023; Su et al., 2023; Tadesse et al., 2022; Wong et al., 2021; Yeh et al., 2019

Promote autonomy	Alhalafawy & Zaki, 2022; Bećirović et al., 2022; Carvalho & Santos, 2022; Inan-Karagul & Seker, 2021; Ingkavara et al., 2022; Ismail & Abdul Hamid, 2024; Karrenbauer et al., 2023; Khalid et al., 2024; Lin & Dai, 2022; Matsuyama et al., 2019; Nikolopoulou, 2023; Omar et al., 2023; Su et al., 2023; Tise et al., 2023; Xu et al., 2022; Zhou et al., 2021
Foster motivation	Bećirović et al., 2022; Elkot & Ali, 2020; Hidayatullah & Csíkos, 2023; Ismail et al., 2023; Kesuma et al., 2020; Kong & Lin, 2023; Matsuyama et al., 2019; Muwonge et al., 2020; Nufus et al., 2024; Omar et al., 2023; Su et al., 2023; Wong et al., 2021; Yeh et al., 2019
Increase self-efficacy	Al-Shaye, 2021; Elkot & Ali, 2020; Ingkavara et al., 2022; Ismail et al., 2023; Kesuma et al., 2020; Khalid et al., 2024; Nguyen & Zarra-Nezhad, 2023; Lee et al., 2021; Martin et al., 2022; Raviv et al., 2023; Tise et al., 2023; Wong et al., 2021; Yavuzalp & Bahcivan, 2021
Personalized learning experienced	Al-Shaye, 2021; Chen, 2023; Ingkavara et al., 2022; Ismail et al., 2023; Karrenbauer et al., 2023; Khalid et al., 2024; Lim et al., 2023; Matsuyama et al., 2019; Osakwe et al., 2023; Raviv et al., 2023; Tadesse et al., 2022; Zhou et al., 2021
Personalized feedback	Inan-Karagul & Seker, 2021; Li et al., 2023; Lukes et al., 2020; Matsuyama et al., 2019; Su et al., 2023

Self-Regulated Learning Challenges

Appropriate infrastructure, digital resources, support, and cooperation are crucial for sustaining blended learning, particularly SRL (Nikolopoulou, 2023). Access to technology is vital for SRL, but limited access can hinder it and impact learning outcomes (Gutiérrez-Pelaez & Ellis, 2020; Ingkavara et al., 2022; Khalid et al., 2024; Núñez et al., 2023; Sevnarayan, 2022). This issue is significant for students facing barriers to digital resources and online tools, affecting their success in online courses. For instance, students in rural areas or underfunded schools often face difficulties accessing reliable Internet and digital devices, which restricts their ability to engage with online learning platforms and use digital tools essential for SRL (Reyes-Millán et al., 2023; Zarestky et al., 2022). Ensuring equitable access to technology requires not only the provision of devices but also digital literacy training to enhance online learning readiness (Carvalho & Santos, 2022; Kay et al., 2022).

Technical challenges, such as connectivity issues, can impede student participation. For example, students participating in synchronous online classes may experience frequent disruptions due to unstable Internet connections, making it difficult for them to stay engaged and keep up with the course content (Inan-Karagul & Seker, 2021; Tadesse et al., 2022). Similarly, asynchronous learners with poor Internet connections may struggle to download necessary materials or submit assignments on time, leading to gaps in learning

(Briones et al., 2023). Effective SRL and e-learning depend on access to information, communication, and technology (ICT) equipment and reliable Internet connections (Abbasi et al., 2020; Almaiah et al., 2020; Choong, 2020; Looi, 2023; Wang et al., 2020). Addressing these challenges requires inclusive strategies to ensure equitable access and strengthen digital infrastructure (Dai et al., 2023; Nikolopoulou, 2023).

Clear instructional design is essential for SRL, promoting goal setting, strategy planning, and adaptive learning (Ingkavara et al., 2022). In practical terms, this means educators need to provide clear guidelines and scaffolding to help students set realistic goals and develop personalized learning plans. Without proper guidance, students may struggle with self-control in online environments (Ingkavara et al., 2022). Clear instructions and scaffolding tools support SRL by providing guidance on self-regulatory processes (Matcha, Ahmad Uzir, et al., 2019; Matcha, Gašević, et al., 2019; Osakwe et al., 2023). Quality instructional materials ensure learners understand tasks and expectations, which is crucial for facilitating self-regulation (Chen, 2023). Teacher guidance and personalized feedback significantly enhance learning outcomes by fostering self-reflection and self-assessment, essential components of metacognitive strategies (Nikolopoulou, 2023; Tzimas & Demetriadis, 2024; Yavuzalp & Bahcivan, 2021). Timely and specific feedback can help students adjust their learning strategies and improve their self-regulation skills, yet in many cases, such feedback is delayed or generic, reducing its effectiveness (Yavuzalp & Bahcivan, 2021).

Resistance to change can impede new SRL methods, necessitating supportive strategies (Khalid et al., 2024). This resistance is common during the transition to online models (Almaiah et al., 2020; Gutiérrez-Pelaez & Ellis, 2020; Looi, 2023; Núñez et al., 2019). Teacher education often prioritizes content knowledge over SRL principles, leading to resistance. For instance, teachers may resist integrating SRL strategies such as self-reflection, goal setting, and help-seeking into their curricula due to a lack of familiarity or confidence in these methods (Faza et al., 2024; Omar et al., 2023; Robbins et al., 2020). Educators need competencies to support self-directed learners, but the lack of SRL emphasis in teacher preparation programs may limit the integration of mobile educational apps, hindering academic success (Omar et al., 2023). In practice, this means that even when mobile apps are available, they are underused or not used to their full potential because educators lack the necessary skills to integrate them effectively into their teaching practices.

The pandemic highlighted significant gaps in instructor training for online teaching impacting SRL outcomes, student success, and attitudes toward online education (Bećirović et al., 2022; Karrenbauer et al., 2023; Khalid et al., 2024; Patiño-Toro et al., 2023; Reyes-Millán et al., 2023). Many instructors were unprepared to facilitate online learning effectively, lacking training in essential SRL strategies such as time management, self-reflection, and monitoring, which are critical for supporting student learning in virtual environments (Chen, 2023). Instructors who are not well-versed in these strategies may find it challenging to foster a self-regulated learning environment conducive to online learning success.

Limited access to learning materials poses significant obstacles to SRL, especially for students lacking resources like international study opportunities or internships (Gutiérrez-Pelaez & Ellis, 2020; Núñez et al., 2023). These challenges can affect students' ability to engage in SRL and manage their learning. For instance, students from low-income backgrounds may have limited access to textbooks or online subscriptions, making it difficult for them to engage fully in their studies and apply SRL strategies effectively (Funa et al., 2023; Funa & Talaue, 2021). To overcome these barriers, employing strategies such as help-seeking and proactive resource management can enhance students' capacity to navigate limited

resources and still achieve their learning goals (Almaiah et al., 2020; Looi, 2023; Zhou et al., 2020). Access to digital resources enhances instructional benefits and accessibility, improving SRL outcomes (Khalid et al., 2024).

Students often face time management difficulties in distance education, impacting their ability to use online resources effectively (Anthonysamy et al., 2021; Turan et al., 2022). For example, juggling multiple deadlines without the structure of a physical classroom environment can lead to procrastination or incomplete tasks, affecting learning outcomes (Osakwe et al., 2023; Reyes-Millán et al., 2023). Despite these constraints, SRL strategies such as self-monitoring and adaptive planning can help students manage time and workload effectively (Omar et al., 2023). The setup of online learning influences task completion, underscoring the importance of SRL (Adnan & Anwar, 2020; Funa et al., 2023).

Students' lack of prior knowledge of motivational regulation strategies highlights the need for university training to enhance SRL self-efficacy (Alotumi, 2021; Howlett et al., 2021; Kryshko et al., 2020; Wang et al., 2021; Zhang et al., 2020). In practice, training on SRL strategies can help students use self-regulated motivation (SRM) effectively, particularly in EFL contexts (Alotumi, 2021; Teng et al., 2020).

Digital competencies are essential for leveraging technological tools in SRL, enabling students to navigate online resources, collaborate effectively, and use learning management systems proficiently (Chen, 2023; Ingkavara et al., 2022; Karrenbauer et al., 2023; Tise et al., 2023). Online learning readiness depends on digital competencies, which are assessed using tools such as the Online Learning Readiness Questionnaire (OLRQ; Reyes-Millán et al., 2023). Students unfamiliar with digital tools may struggle to access online resources or participate in collaborative online projects, hindering their ability to fully engage in SRL (Chen, 2023). Developing digital competencies also involves understanding and applying metacognitive strategies, such as monitoring one's own learning progress and seeking feedback, which are vital for successful SRL in digital environments. Table 6 presents various challenges in implementing SRL identified in the literature, along with supporting source references.

Table 6

Self-Regulated Learning Challenges and Source References

Challenge	References
Limited access to technology	Abbasi et al., 2020; Almaiah et al., 2020; Briones et al., 2023; Carvalho & Santos, 2022; Choong, 2020; Dai et al., 2023; Elkot & Ali, 2020; Gutiérrez-Pelaez & Ellis, 2020; Inan-Karagul & Seker, 2021; Ingkavara et al., 2022; Kay et al., 2022; Khalid et al., 2024; Looi, 2023; Nikolopoulou, 2023; Núñez et al., 2023; Omar et al., 2023; Reyes-Millán et al., 2023; Sevnarayan, 2022; Tadesse et al., 2022; Wang et al., 2020; Zarestky et al., 2022
Instruction clarity	Bećirović et al., 2022; Chen, 2023; Ingkavara et al., 2022; Mapuya, 2022; Matcha et al., 2019; Nikolopoulou, 2023; Omar et al.,

	2023; Osakwe et al., 2023; Tzimas & Demetriadis, 2024; Yavuzalp & Bahcivan, 2021
Resistance to change	Almaiah et al., 2020; Chen, 2023; Gutiérrez-Pelaez & Ellis, 2020; Khalid et al., 2024; Looi, 2023; Matsuyama et al., 2019; Núñez et al., 2023; Omar et al., 2023; Robbins et al., 2020; Turan et al., 2022
Instructor lack of training	Bećirović et al., 2022; Chen, 2023; Karrenbauer et al., 2023; Khalid et al., 2024; Omar et al., 2023; Park & Kim, 2023; Patiño-Toro et al., 2023; Reyes-Millán et al., 2023
Limited access to learning material	Almaiah et al., 2020; Funa et al., 2023; Funa & Talaue, 2021; Gutiérrez-Pelaez & Ellis, 2020; Khalid et al., 2024; Looi, 2023; Núñez et al., 2023; Zhou et al., 2020
Time and workload constraints	Adnan & Anwar, 2020; Anthonysamy et al., 2021; Chauncey & McKenna, 2023; Funa et al., 2023; Omar et al., 2023; Osakwe et al., 2023; Reyes-Millán et al., 2023; Turan et al., 2022
Student lack of knowledge	Alotumi, 2021; Howlett et al., 2021; Kryshko et al., 2020; Teng et al., 2020; Wang et al., 2021; Zhang et al., 2020
Digital competencies	Chen, 2023; Ingkavara et al., 2022; Karrenbauer et al., 2023; Reyes-Millán et al., 2023; Tise et al., 2023

Conclusion

This study highlights the pivotal role of self-regulated learning (SRL) in fostering academic success. By incorporating SRL strategies such as goal setting, cognitive and metacognitive processes, time management, self-reflection, and help-seeking, students can effectively manage their learning processes. Integrating these strategies with technological tools such as learning management systems (LMS), massive open online courses (MOOCs), and artificial intelligence (AI) significantly enhances students' ability to set and achieve goals, monitor progress, and stay engaged, particularly in online and blended learning environments. Technological advancements have revolutionized education, making robust SRL skills essential for maintaining motivation and preventing dropout in digital learning contexts. AI and collaborative platforms offer personalized learning paths and support, while mobile learning and learning analytics provide accessible, interactive resources and enable continuous self-monitoring and strategy adjustment. However, implementing IT-supported SRL strategies faces challenges, including limited access to technology, the need for digital literacy, effective time management, resistance to change, and inadequate instructor training. Overcoming these barriers is crucial for creating inclusive and effective educational environments. Ensuring equitable access to technology, offering digital literacy training, and enhancing digital infrastructure are necessary steps.

This study also advances the SRL theoretical framework by integrating strategies with modern technology, emphasizing accountability, planning, collaboration, and communication. It provides a comprehensive understanding of improving SRL through digital means, illustrating its importance for lifelong learning and job market readiness. The research highlights the shift in educational paradigms due to technological advancements and the COVID-19 pandemic, emphasizing the need for robust SRL skills in online learning.

For educators, this research offers insights into implementing SRL strategies using IT tools, helping design practices that foster accountability, planning, collaboration, and communication. Policymakers can promote digital literacy and SRL training in educational programs, addressing barriers such as technology availability and digital capability to create inclusive environments. The research underscores supporting students in developing strong SRL skills to maintain motivation and prevent dropout, especially in online learning contexts.

Limitation

Despite the insightful findings of this study, several limitations must be acknowledged, primarily stemming from the restricted scope of the journal databases used. First, the study's reliance on only two journal databases may have limited the comprehensiveness of the literature review. This constraint could result in potential biases, as important studies and diverse perspectives from other relevant databases may have been overlooked. Consequently, the findings and recommendations might not fully capture the breadth of existing research on SRL and its integration with technological tools.

Furthermore, the rapidly evolving nature of technology means that some studies included in the database might already be outdated, failing to account for the latest advancements in AI, mobile learning, and learning analytics. This temporal limitation could impact the relevance and applicability of the findings to current educational contexts. As technology continues to advance at a rapid pace, ongoing research is necessary to keep pace with these changes and to validate the continued relevance of the findings presented in this study.

Future Research

Future research should explore the perspectives and experiences of various educational stakeholders, such as faculty members and administrators, to understand better the implementation and efficacy of SRL strategies. Examining these insights can refine SRL interventions and ensure their practical applicability in diverse educational settings. Empirical testing of SRL strategies and supporting technologies is essential to substantiate their benefits and identify obstacles. Studies should evaluate the effectiveness of SRL strategies integrated with tools such as LMSs, MOOCs, and AI in different learning environments. This research will help understand the impact of these strategies on student performance, engagement, retention, and academic achievement. Additionally, future research should investigate challenges related to digital literacy, equitable access to technology, and instructor training in implementing IT-supported SRL strategies. By examining these factors, researchers can help develop targeted interventions and professional

development programs to enhance digital literacy among students and educators. Identifying best practices for overcoming resistance to change and fostering continuous improvement in educational institutions is crucial for adopting SRL strategies.

Acknowledgements

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