A Systematic Literature Review on Technology-Assisted Self-Regulated Language Learning: Tools, Challenges and Outcomes

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Abstract: This systematic literature review (SLR) explored the role of technology in enhancing self-regulated language learning (SRLL) and identified factors influencing its effectiveness. The review addressed three research questions: the types of technology used in SRLL studies, how technology facilitates SRLL, and the factors affecting the success of technology-enhanced SRLL. A total of 13 quantitative research articles published between 2019 and 2023 were selected from Web of Science and Scopus databases using specific inclusion and exclusion criteria. The findings revealed that various technological tools, including Learning Management Systems (LMS), mobile applications, online resources, and digital storytelling platforms, support SRLL. Most studies indicated that technology positively impacts learners' self-regulation skills and academic outcomes, particularly through fostering autonomy and motivation. However, some studies reported mixed results, suggesting that the effectiveness of technology-assisted SRLL depends on several factors. This review demonstrated that the key factors include tailoring content to learners' profiles, enhancing motivation, providing educator support, considering learners' interests, and ensuring policy support for technology integration. The review highlighted the need for well-designed technology-assisted learning environments to maximise the potential benefits of SRLL and calls for further research to address inconsistencies in the literature.

Keywords: Language learning, self-regulated, technology

Introduction

In the modern era, technology has transformed nearly every aspect of our lives, including how we approach learning. With the fast-paced advancement of technology, the distinction between formal and informal learning, as well as based learning and out-of-class activities have become interconnected (Sharples et al., 2016). Technology allows teaching and learning to be more flexible in terms of time, place and pace.

Technology and Self-Regulated Learning

Both learners and educators should leverage the advantages that technology brings. One way of doing this is by encouraging self-regulated learning (SRL). According to Pintrich (2000), Self-regulated Learning is an active, purposeful process where learners set goals and actively monitor, manage, and

control their cognitive, metacognitive processes, and learning behaviours. Having learners taking control of their own learning is crucial because without the willingness to be autonomous, it is less likely that learners will be able to be engaged with their learning. Myriad of studies had shown a positive connection between SRL and the learners' learning outcomes (Chen et al., 2014), proving that emphasizing on self-regulation would be beneficial. When combined with technology, this process becomes even more powerful. Digital tools and platforms provide learners with unprecedented access to resources, feedback, and opportunities for practice. Technology-assisted self-regulated language learning grasps a variety of digital resources such as language learning apps, online courses, virtual tutors, and interactive exercises. These tools not only facilitate easier access to language materials but also enable learners to track their progress, adjust their learning strategies, and stay motivated.

Self-Regulated Learning Framework and Technology

The study of self-regulated learning has been highly influenced by Zimmerman (2000) which stated that self-regulation occurs in a cyclical process involving three stages: forethought, performance, and self-reflection. In the forethought phase, individuals set goals and develop strategies to achieve them. During performance, they execute their plans while maintaining focus and control. Finally, in the self-reflection stage, they assess their outcomes, identifying successes and areas for improvement. This continuous cycle enhances learning and personal growth, helping individuals become more effective in reaching their goals. Bartolomé and Steffens (2011) stated that technological advancement has allowed educators to design technology-enhanced learning environments that could foster self-regulation. This could be achieved by fulfilling the following criteria: 1) Learners should be encouraged to plan their learning activities; 2) Learners should receive appropriate feedback so that they can monitor their learning; and 3) Learners should be given criteria so that they can evaluate their own learning outcomes. These are in line with the 3-stage framework by Zimmerman.

Technology-Assisted Self-Regulated Language Learning

Over the years, many studies had demonstrated that technology-enhanced learning environments can provide technological advantages that can enhance language learning outcomes and promote self-regulated learning (SRL) skills (Woottipong, 2022). Nevertheless, there are also studies indicating that technology does not have positive impacts on language learning outcomes (Chen & Lee, 2018) or SRL skills (Seifert & Har-Paz, 2020). This inconsistency in findings could be due to the design of technology-assisted learning environments. A well-designed technology-enhanced learning environment can support learners in regulating their learning, deciding when and where to study, fostering SRL behaviours, and maintaining interest in SRL (Shih et al., 2010).

In recent years, research on SRL in online learning environments has significantly increased. Researchers had examined multiple facets of SRL, such as trends in assessment and intervention tools (Araka et al., 2020), the link between SRL strategies and academic success in online higher education (Broadbent & Poon, 2015) and methods for fostering SRL in online learning environments (Wong et al., 2018). On the other hand, Palalas and Wark (2020) had explored the connection between SLR and mobile learning while Viberg et al. (2020) looked upon the association between SRL and learning analytics in online education. Despite this growing body of research, comprehensive reviews of technology-assisted self-regulated language learning (SRLL) are still relatively limited (Yang et al., 2022). The lack of studies and review done specifically in terms of language learning indicates a gap that requires for further investigation into how technological tools can be optimally utilized to support SRL in language learning, as well as how these tools can be effectively integrated into educational practices to maximize their potential benefits.

As the educational landscape continues to evolve with technological advancements, it is essential to remain mindful of the design and implementation of technology-assisted learning environments. By addressing the inconsistencies in research findings and exploring new ways to enhance SRL through technology, educators and learners can better navigate the complexities of modern learning and achieve more effective educational outcomes.

This review aimed to provide a comprehensive understanding of the role technology plays in promoting self-regulated language learning and uncovered the key elements that contribute to its success. Thus, in order to fulfil the objective, this SLR attempted to answer the following research questions:

1. What are the types of technology used in the studies on technology-assisted SRLL?
2. How does technology facilitate self-regulated language learning (SRLL)?
3. What factors influence the effectiveness of technology- enhanced SRLL?

Methodology

Generally, this review sought to offer a thorough insight into how technology supports self-regulated language learning and identified the essential factors that contribute to its effectiveness. Thus, the best method to be used in answering the research questions addressed in this paper is by employing Systematic Literature Review (SLR) to ensure a more inclusive and structured review. Therefore, the insights from various previous studies could be focused and acknowledged. According to Xiao and Watson (2019), SLR can enhance the quality, dependability, and validity of the review being conducted. Of the few methods available, this SLR utilized the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Page, et al., 2021) to ensure the quality of the review process.

Search Strategy

The data for this study were gathered from two main academic journal databases which are Web of Science (WOS) and Scopus. The search was done in early August 2024. These databases are widely used in educational studies (Bano et al., 2018; Lee, 2019; Lin & Lin, 2019). First, the common relevant terms used in the literature, along with their synonyms and alternative spellings, were identified. This is to ensure that the search string would cover most of the related research that could be included in the review. After reviewing all the related keywords, the following search string (Table 1) was then used to search for the relevant articles:

Table 1. Search string used for each database

Database	Search String
Web of Science	TS=(("technolog*" OR "computer*" OR "mobile*" OR "tablet*" OR "phone*" OR "smartphone*" OR "handphone*") AND ("self-regulat*") AND ("language* learn*") AND ("English"))
Scopus	TITLE-ABS-KEY (("technolog*" OR "computer*" OR "mobile*" OR "tablet*" OR "phone*" OR "smartphone*" OR "handphone*") AND ("self-regulat*") AND ("language* learn*") AND ("English"))

Selection of Articles

Based on the search done from the two databases, a total of 205 related articles were found. 61 duplicate articles were taken out, leaving the remaining 144 articles for screening. The screening process began by filtering the articles based on the following inclusion and exclusion criteria in Table 2:

Table 2. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Indexed Journal (Research Article)	Non-indexed journal, review articles, chapter in book, conference proceeding
Published in English	Published in other languages

| Published from 2019-2023 | Published before 2019, or after 2023 |
| Related to technology in English language learning | Not related to technology in English language learning |

Only peer-reviewed articles that were accessible online were included to maintain the high quality of the selected studies (Hung et al., 2018). Articles from non-indexed journals were not included and the same goes to review articles, chapters in books, and conference proceedings. This is to ensure that the focus will be on research papers. The next step was to filter the articles to include only those published between 2019 and 2023. The authors restricted their search to articles published within the last five years to ensure the data obtained is current and relevant (Gottlieb, 2003).

Then, articles written in languages other than English were taken out of the search. After that, the articles were screened to determine their relevance to the topic. Any unrelated articles to technology in English language learning were excluded. At the end of the filtering process, a total of 85 articles were excluded based on the established inclusion and exclusion criteria.

After the first stage of the screening process, 59 articles were sought for retrieval. However, 13 articles were not retrieved, leaving another 46 articles to be assessed for eligibility. Another 33 articles were excluded after failing to pass certain eligibility criteria, which include articles other than quantitative studies (n=17), review papers (n=7), unrelated to the topic (n=4) and articles involving English majors, teachers and special needs learners (n=5). Only quantitative studies were included in this review as quantitative methods are more objective, specific and systematic in its findings thus making the discussion easier and more focused (Mohajan, 2020). As a result, only 13 documents were used for this SLR. The articles selection process PRISMA is outlined in Figure 1.
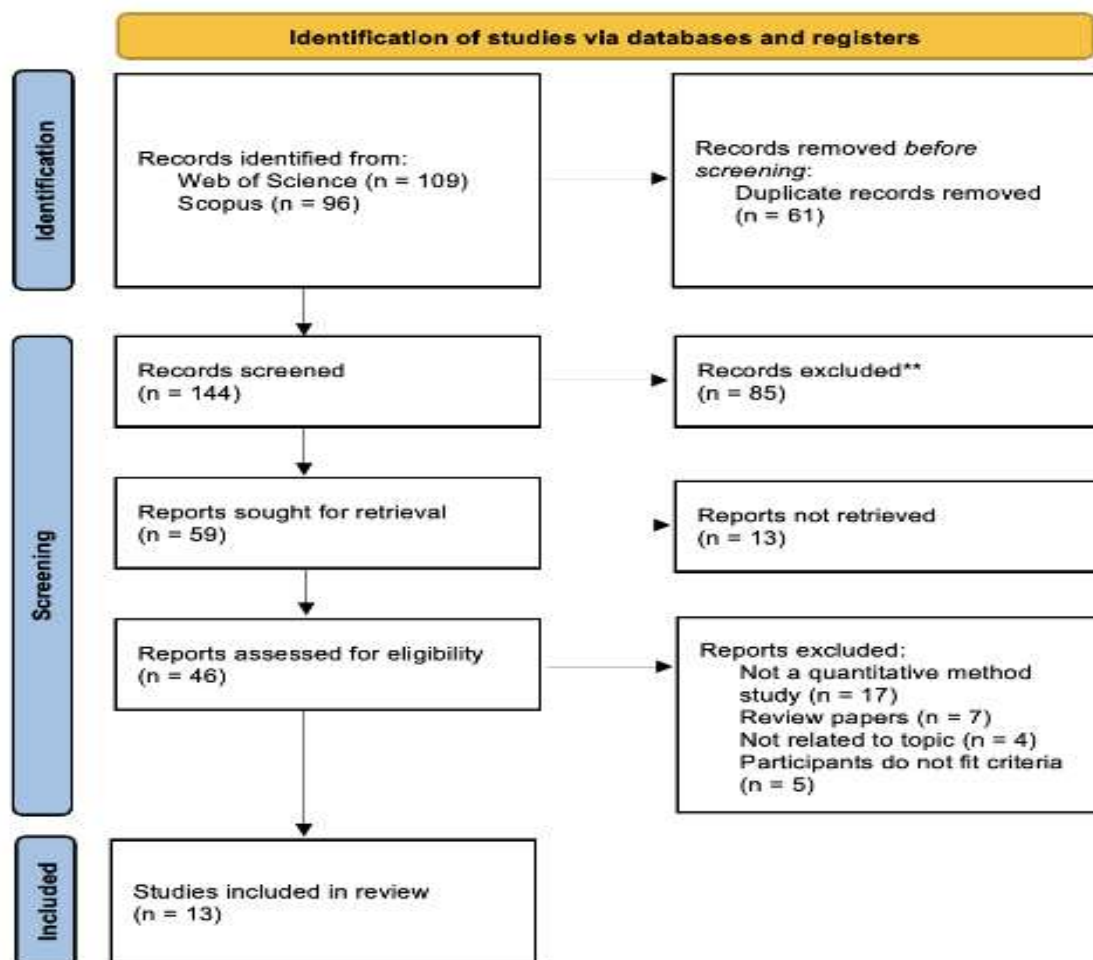

Fig. 1 Systematic Review Strategy Guidelines based on Page, et al. (2021)

Findings and Discussion

Types of Technology Used

The growth of the world of technology has led to developments of countless forms of technology-based tools for learning. Some were created specific for a certain course and others were made for general use. As for the 13 articles being reviewed, most studies made use of multiple tools and only 5 studies made use of a specific tool (Gholizadeh & Rahimi, 2023; Higushi et al., 2020; Amirinejad & Rahimi, 2023; Imamyartha, 2023; and Szabo et al., 2022). This clearly answers the first research question addressed in this study.

Two studies, by Tao et al. (2020) and Wang (2023), made use of the institution's Learning Management System (LMS) where all the teaching and learning material are made available for the learners to access and study in preparing for the lesson. Tao et al. (2020) used the LMS to study the learners' profiles and their different Online Self-Regulated Learning strategies, while Wang (2023) studied the effectiveness of three different teaching methods: Flipped Instruction (FI), Online-Flipped Instruction (OFI) and Traditional Instruction (TI). Another study by Ozawa (2019) which looked at the effect of learners' characteristics towards their behaviours in an online class, on the other hand, made use of a Commercial English online learning platform. Five studies utilized the vast online resources for learning (Lai et al., 2022; Pavel, 2022; An et al., 2021; and Lei et al.,2022) which included the use of online forums, public channels, digital games, audio-visual resources, podcasts, social media and mobile applications.

Gholizadeh and Rahimi (2023) conducted the study on the use of AutoCorrect on the learners' vocabulary size while Higushi et al. (2020)'s study utilized Skype as the tool to conduct online lessons based on their chosen materials. Amirinejad and Rahimi (2023) conducted their study on the use of digital storytelling where the application StoryJumper were used to create the digital storybooks and Szabo et al. (2022) made use of a self-developed tool named HANNA which is a tablet-based digital language course programme. However, there is one study that did not specify the tool that was used where the learners basically employed their own preferred tool at their own time for the online learning (Wang et al., 2023).

Based on this distribution, it can be seen that most research conducted in this area focused on the use of online learning platforms and most of them made use of the available online resources as there are varieties of resources to choose from. In answering the first research question on the types of technology used in the studies on technology-assisted SRLL, it is discovered that only 5 studies made use of a specific tool, while the other studies made use of multiple tools in carrying out the teaching and learning process. The usage of various tools and resources is needed to ensure that the various learners' needs are fulfilled (Tao et al., 2020). This is because there are quite a number of learners in one class, and thus in order to fulfil everybody's needs and to teach various skills, various methods and tools need to be used. Table 2 illustrates the summary of the technology used in the studies.

Table 2. Summary of the technology used in the studies

No	Paper	Use of Technology	Description	Setting F	I
1	Tao et al. (2020)	Learning Management System (LMS)	Blended-teaching mode: Learners access resources (reading materials, lecture slides, tutorial recordings and discussion boards) through online LMS		/
2	Wang et al. (2023)	Not specified	Use for online English learning	/	
3	Ozawa (2019)	Commercial English online learning platform	Learners access personalized learning materials (according to their diagnostic test results) through smartphones or computers.		/
4	Wang	Institution's	Learners review and understand materials at	/	/

No	Author	Tool	Description	F	I
	(2023)	Learning Management System (LMS) & Zoom Webinar Video	their own pace and participate in collaborative activities.		
5	Lai et al. (2022)	Online & Digital English Resources	Learners make use of online forums, public channels, digital games, audio-visual resources, podcasts, social media and mobile apps.		/
6	Pavel (2022)	Online Learning Resources	Learners access seminars, articles and videos online.	/	/
7	An et al. (2021)	English Songs and Movies	Using multimedia resources to practice and enhance language skills.		/
8	Lei et al. (2022)	1-year Mobile-assisted Language Learning (MALL) Programme	Learners make use of e-dictionaries, widgets, English songs, social networking applications and others.	/	/
9	Gholizadeh & Rahimi (2023)	Autocorrect	Learners make use of Autocorrect software.		/
10	Imamyartha (2023)	Team-based Mobile Language Learning	Learners make use of a mobile application to engage in conversations and complete tasks.	/	
11	Higushi et al. (2020)	Skype	Learners participate in Skype lessons according to their chosen time and materials.		/
12	Amirinejad & Rahimi (2023)	StoryJumper	Learners create digital storybook using the application.	/	
13	Szabo et al. (2022)	HANNA – tablet-based digital language course programme	Learners participate in a gamified digital supplementary course material.	/	

F – Formal, I – Informal

Role of Technology in Enhancing Self-Regulated Language Learning

In terms of the effectiveness of technology in improving learners' self-regulated learning and achievement, various results were reported by these studies. Most of the studies indicated a positive result, for instance, based on the study on flipped instruction conducted by Wang (2023), it was found that since the online flipped instruction allowed learners to access the online materials on their own at their own time, it contributed to a greater engagement with the materials. The higher retention of materials contributed to higher test scores. This led to autonomy and control over the learning and eventually encouraged a higher level of metacognitive awareness among the learners. This is similar to the findings by Lei et al. (2022) which found that learners became more autonomous in their vocabulary learning, utilizing self-regulation strategies such as goal setting, self-monitoring and seeking help more effectively. This is because through the use of Mobile-Assisted Language Learning (MALL), learners can participate in collaborative activities at all times, creating a more convenient and motivating learning environment. This is supported by Lu (2008) who also claimed that MALL fosters retention of language learning skills, putting MALL as a method that allows for a shift from teacher-driven learning to a learner-driven learning.

Another finding which indicated a similar effect in using technology is in the study conducted by Gholizadeh and Rahimi (2023) where it was found that the use of AutoCorrect (AC) supports autonomous learning by providing tools for self-monitoring and strategy implementation. In their study on the use of AC and vocabulary size, it was found that learners, who used AC more frequently

and effectively and possessing strong self-regulation skills, tended to have a larger vocabulary size. The self-regulation skills involved included the setting of learning goals, monitoring of progress and employment of various strategies. Other than vocabulary, learners' reading and writing skills are also positively impacted through the use of technology. This was proven through the study done by Amirinejad and Rahimi (2023) where they found that by using StoryJumper to create digital story, learners showed better engagement in writing practices, creativity and critical thinking which are important for literacy development. It significantly enhanced learners' academic self-regulation because creating their own stories foster motivation and self-esteem. The study by Szabo et al. (2022), also indicated that there was a noticeable improvement in language skills and motivation after participating in the study involving the use of the self-developed tablet-based digital language course programme – HANNA.

However, despite all the positive reports, Ozawa (2019) found that high self-regulation and readiness to use ICT did not directly translate into higher scores. Other than that, a study by An et al. (2021) also found that using songs and movies did not significantly impact learning outcomes, indicating that simply engaging with English media may not be sufficient for effective learning. It was also discovered that using apps and other digital tools specifically designed for vocabulary acquisition did not have a notable impact on learners' learning outcomes. Nonetheless, in general, despite having a contrasting result for vocabulary, the study did notice a positive relationship between technology-based SRL strategies and learners' English learning outcomes. This finding aligns with other research on the relationship between SRL strategies and academic achievement in second language learning (Bai & Wang, 2020). The study done by Pavel (2022) revealed that while technology allowed the learners to have a high degree of autonomy and responsibility for their learning, their motivation and effectiveness were closely tied to the learning environment, with traditional face-to-face classes being preferred over online ones. The learners seemed to still prefer the traditional face-to-face classes due to the lack of feedback for online lessons.

Based on these findings from these papers, it is evident that the use of technology in teaching and learning can have various effects on learners' achievement as well as on their self-regulatory learning behaviour. The report illustrated the significance of technology in allowing learners to take charge of their own learning (Jansen et al., 2020). This is because the existence of technology and all the available resources allow learners to be less dependent on the instructor. They can explore on their own, at their own pace and at their own time. While consciously being more autonomous in their learning, they begin to develop stronger self-regulation skills and eventually evolve into more self-regulated learners, which is important in becoming a more successful learner in general. Hence, it is proven that technology does facilitate SRLL, as addressed in the second research question. Technology provides resources that allow learners to take responsibility for their learning and become less reliant on the instructors. This independence fosters the development of stronger self-regulation skills, helping them evolve into more self-directed learners, which is crucial for overall academic success. These are all supported by the framework by (Zimmerman, 2000) as well as the criteria given by Bartolomé and Steffens (2011) which indicated that in order for technology to foster self-regulation skills, it must allow students to plan their learning, receive feedback for their learning as well as evaluate their own learning.

However, despite the advantages that come with technology, there are still instances where technology does not quite help in boosting their achievement as proven by the studies being reviewed. This is because, based on the reports from these studies, there are factors that need to be considered in order for its implementation to be successful.

Factors to be considered when using Technology to Promote Self-Regulation in Language Learning

Tailoring Content to Learners

Tao et al. (2020) put emphasis on the importance of understanding their profiles before designing the intervention to address specific needs of these learners. For instance, more challenging tasks should be given to learners with high commitment while learners with low engagement should be assigned with more interest-arousing tasks to motivate them to perform better. Other than tailoring the content

to their profile, taking into consideration their personal goals and motivation is also crucial (Wang et al., 2023). Incorporating aspects of English-speaking cultures could help to maintain engagement and this will increase self-regulation.

Enhancing Learners' Motivation

To foster effective self-regulation and goal setting, it is important for educators to help enhance learners' motivation. This can be done by promoting intrinsic motivation, setting clear goals and providing structured feedback (Tao et al, 2020). This will keep learners motivated and engaged in their learning. In addition to that, according to Haw and King (2022), if learners are not prepared for an online lesson, it might make them feel anxious, thus decreasing their motivation for online learning. Therefore, educators should prepare good materials for learners to preview before class so that they feel more prepared, less anxious hence becoming more motivated to participate in the lesson. Other than that, course assessments and tasks need to be more focused on application of theories for learners who are more career-oriented to increase their motivation in computer assisted language learning (Wang et al., 2023). On top of all these, An et al. (2021) encouraged educators to undergo a professional development focusing on motivational techniques to help them better support learners' use of technology-assisted SRL strategies.

Support from Educators

According to Ozawa (2019), since every learner is different, it becomes vital for educators to provide support and guidance to learners to encourage them to participate better in technology-assisted language learning. On the other hand, Wang (2023) highlighted that in order for an online collaborative flipped classroom to successfully promote self-regulated learning behaviours like time management, goal setting and progress monitoring, educators need to provide support and explicit instruction so that learners can take charge of their own learning process. Lai et al. (2022) also mentioned support from educators, however, putting the focus on the different proficiency levels. They highlighted the fact that learners with different levels of proficiency would require different types of support. Similarly, Pavel (2022), in her study stated the importance of the educators' role in online learning. Even though medical students are generally highly motivated and ready to take charge of their own learning, they still think that educators play a significant role in providing effective feedback and preparing interactive activities to maintain learners' engagement (Imamyartha et al., 2023).

Considering Learners' Interest

The study by Lai et al. (2022) focused on learners' interest construct as an important factor in learners' willingness to participate in technology-assisted language lessons. Even though self-regulation is a significant predictor of engagement in instruction, information and socialization-oriented technological activities, their findings indicated that interest played a crucial role in self-directed informal learning, particularly in entertainment-oriented technological activities. This means that self-regulation skills alone are not enough in getting learners to participate in technology-assisted language lessons effectively. This is because, according to Bai and Wang (2023), learners choose the different tasks and activities based on their motivation and interest. Jeong et al. (2018) support this by stating that interest is a vital factor in maintaining informal learning.

Support for Integration of Technology

Finally, policy makers should support the integration of advanced technology in teaching and learning of English to cater to the diverse needs of learners. Despite that, the usage of technology should be balanced with other traditional resources to prevent potential declines in motivation and engagement over time (Imamyartha et al., 2023). In any implementation, certainly the support from policy makers and administrators is crucial in order to ensure its effectiveness and sustainability.

Therefore, it can be concluded that the potency of technology-enhanced self-regulated language learning is influenced by multiple factors, primarily revolving around learner motivation, educator support, and personalized content. In other words, the effectiveness of technology-enhanced self-regulated language learning is shaped by a combination of tailored content, motivational strategies, educator support, learner interest, as well as support for technology integration and these certainly answer the last research question; What factors influence the effectiveness of technology- enhanced self-related language learning?

Conclusion

The importance of language use in a globalised world should stimulate concern for the support of self-regulated language learning (SRLL) through technological means. Collaboration can be enhanced through computer-mediated communicative activities in online or blended learning settings, enabling learners to take control over their learning processes, pace and time. Therefore, this systematic literature review had demonstrated invaluable insights into the role of technology in supporting self-regulated language learning (SRLL) as it highlighted a wide range of technological tools such as Learning Management Systems, mobile apps, and digital platforms. Of the tools reviewed in this paper, making use of learning management systems which combine various online resources seems to be the most effective. This is because the combination of resources provides variations and thus allows for various skills and levels to be covered.

However, while most studies showed that technology enhances self-regulation skills and academic performance, the success of technology-assisted SRLL depends on several other factors. In detail, tailoring content to learners' profiles, enhancing motivation, providing educator support, considering learners' interests, and ensuring policy support for technology integration are all essential elements for maximizing the potential benefits of self-regulated language learning. Indirectly, this review emphasized the importance of creating well-structured technology-enhanced learning environments that can assist learners to fully capitalize the advantages of self-regulated language learning.

Thus, educators should consider making use of technology as part of their teaching and learning in class since most studies indicated that technology helped in moulding students to become better at self-regulating their learning which in the end contributed positively to their academic performance. The stakeholders should also be more open and supportive towards these changes and provide financial support to better equip education institutions with the necessary facilities for the implementation of technology to be possible.

To sum up, the findings underscore the need for thoughtfully designed technology-enhanced learning environments to fully realize the benefits of SRLL. Nevertheless, further research is necessary to resolve the mixed results that may influence the effectiveness of technology-enhanced self-regulated language learning and address the inconsistencies in the current literature.

Suggestion for Future Research

The upcoming research should consider looking into studies done qualitatively as they might provide more detailed insights in the issue. Other than that, since this review did not focus on any level of education, future studies might want to focus on a certain level of education as it might provide a different output. By continuing to investigate this scope of research, educators and researchers can develop more effective strategies for incorporating technology to support self-regulated language learning and optimize learning outcomes.

Co-Author Contribution

The authors confirmed that there is no conflict of interest in this article. All the authors had contributed to the review. Nurhazwani Abd Halim planned the review, did the analysis and

interpretation of the results. Nurul Jannah Ahmad Ghulamuddin conducted the article search, wrote the introduction and prepared the reference list. Awatif Obaid wrote the abstract, selected and reviewed all the articles to be included in the SLR together with Aimi Syafiqah Ghazali, and Nurain Jantan Anua Jah. All the authors contributed in writing the final article, either as editors or reviewers.

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