

The Impact of an AI-Based Educational Platform on Student Teachers' Self-Regulated Learning

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Abstract: This study investigated the effectiveness of an AI-based lesson planning platform in enhancing self-regulated learning (SRL) skills among student teachers at Sultan Qaboos University. To address a critical gap in AI–SRL integration within Middle Eastern teacher education contexts, this research developed a culturally adapted, Arabic-enabled platform aligned with national curriculum standards. Utilizing a quasi-experimental pre-test/post-test design, the SRL skills of an experimental group ($n=14$) using an AI-based lesson planning platform were compared with those of a control group ($n=15$) who followed traditional lesson planning methods. During a four-week intervention, the AI-based platform was utilized to streamline the planning process by providing ready-made lesson plans that adapt to teachers' objectives, strategies, and evaluation methods. The platform enables teachers to customize and modify each section of their plan by offering personalized suggestions tailored to the instructional needs of each teacher. An SRL questionnaire was constructed and validated for data collection. This instrument comprised 20 items across four dimensions: short-term planning, real-time self-monitoring, rapid self-evaluation, and adjustment of strategies. The questionnaire demonstrated excellent psychometric properties, exhibiting good overall internal consistency (Cronbach's $\alpha = 0.89$), with individual dimension reliabilities ranging from 0.79 to 0.87, and good test–retest reliability ($r = 0.84$). Content validity was established by a review conducted by six expert faculty members specializing in educational psychology and teacher education, while construct validity was confirmed using an exploratory factor analysis that revealed a four-factor structure explaining 68.5% of total variance. The statistical analysis indicated a significant improvement in the SRL dimensions for the experiential group, rising from a pre-test mean of 75.07 ($SD=10.5$) to a post-test mean of 102.20 ($SD = 12.5$), $t(13) = -6.93$, $p = 0.005$. This yields an average gain of 26.93. In contrast, the control group exhibited no significant increase, with only a slight mean improvement of 6.87 (pre-test: $M = 78.8$, $SD = 11.5$; post-test: $M = 85.67$, $SD = 13.0$; $t(14) = -1.8$, $p = 0.438$). The positive effect was evident across all four SRL sub-dimensions, highlighting the inclusive impact of the AI-based platform. This research advances the field of AI in education, with substantial implications for curriculum design for teacher education and professional development.

Keywords: self-regulated learning, student teachers, AI-based educational platform, teacher education, lesson planning

1. Introduction

In an increasingly complex and rapidly evolving educational landscape, students' ability to control their own learning has become more critical than ever (Zimmerman, 2002). Self-regulated learning (SRL) is a cornerstone of this educational autonomy, empowering students to become active, engaged, and effective learners (Pintrich, 2000). SRL is a multifaceted construct that encompasses the thoughts, feelings, and actions individuals generate to attain their learning goals (Schunk & Zimmerman, 2008). It is, therefore, not merely a set of academic skills; it is a proactive process that enables students to manage their learning experiences, adapt to challenges, and ultimately achieve academic success (Winne & Hadwin, 1998). The development of SRL skills is a key objective of modern education, as it equips students with the necessary tools to become lifelong learners who can navigate the demands of higher education and the professional world. While some students naturally develop SRL strategies, many require explicit instruction and support to cultivate these essential competencies. The adoption of artificial intelligence (AI) in teacher education is rapidly transforming pedagogical practices, offering new opportunities for teaching and learning (Mutiga, 2024). Academics and innovators have developed AI-powered tools to support student teachers in improving crucial skills, such as lesson planning (Van den Berg & Du Plessis, 2023). Existing systematic reviews have demonstrated that AI applications can be used in higher education to successfully support SRL (Lan & Zhou, 2025).

The present research explores how an AI-based platform helps student teachers at Sultan Qaboos University (SQU) in the process of designing their lessons. The study examines the effectiveness of this platform in improving teachers' SRL skills, which are essential for quality teaching and continuous professional development (Sakamoto et al., 2024). Lesson planning is a core competency for teachers that requires multifaceted interaction among content knowledge, pedagogical strategies, and awareness of student needs (Kehoe, 2023). Recent advances in SRL facilitated by AI applications have produced multilayer taxonomies (Grüneke et al., 2024). Students can find traditional lesson planning methods time-consuming and demanding as they continue to build their pedagogical expertise. AI-driven platforms provide a promising solution by structuring support, generating ideas, and delivering feedback to scaffold students' lesson planning process (Wong & Viberg, 2024). This study

argues that leveraging such platforms can enhance the quality of lesson plans while improving SRL, practical goal setting, self-reflection and time management skills. Meta-analyses show that SRL scaffolds in computer-based environments enhance academic performance (Zheng et al., 2016). This study therefore explores how AI tools can be used to improve teacher preparation and support the development of competent, self-regulated teachers at SQU. As a key institution for teacher education, SQU is particularly well-positioned to benefit from this research, as its teacher preparation programs can directly apply the study's insights to enhance student teachers' self-regulated learning and integration of AI tools in lesson design.

2. Research Gap and Problem Statement

The concept of SRL has its foundations in social cognitive theory, which emphasises the dynamic interplay among personal, behavioural, and environmental factors (Zimmerman & Schunk, 2018). Zimmerman (2002) defined SRL as a cyclical process involving learners setting goals, applying strategies, monitoring progress, and evaluating outcomes, reflecting the metacognitive, motivational, and behavioural dimensions of active learning (Panadero, 2017; Schunk & Greene, 2018). Research has consistently demonstrated strong positive correlations between SRL and academic achievement across age groups and disciplines (Theobald, 2021; Jansen et al., 2019). Students with effective SRL skills show higher achievement, stronger motivation, and improved self-efficacy, which are essential qualities for navigating today's information-rich environments (Wong et al., 2019; de Ruig et al., 2024). Despite the established benefits, there are several gaps in the SRL literature. Methodologically, it is dominated by correlational designs, rather than experimental or quasi-experimental methods, which limits the ability to make causal claims (Dignath & Büttner, 2008; Panadero, 2017). Reviews reveal that fewer than one-third of interventions employ rigorous control-group designs, and many use small samples, reducing statistical power (Cleary et al., 2021; Vilkova, 2022). Culturally, most SRL studies are conducted in Western contexts, limiting the generalizability of findings across diverse educational settings (McClelland & Wanless, 2015; McInerney & King, 2018; Xu et al., 2023). Traditional frameworks often fail to reflect the collective values, social norms, and learning strategies that characterize non-Western cultures (Anyichie et al., 2023; Haslam et al., 2019). Moreover, limited integration of co-regulation processes involving teachers, peers, and caregivers has left the social and collaborative dimensions of SRL largely underexplored in teacher education, particularly within non-Western contexts such as Oman (Bransen et al., 2022; Tauber et al., 2023) and insufficient attention to the sustainability of SRL strategies, with few studies examining long-term adoption (Akdeniz, 2022; Suhandoko & Hsu, 2020; Lobos et al., 2024). Additionally, despite the strong influence of peer and social learning contexts on adolescent development, these areas remain underexplored (Wu et al., 2023; Fan et al., 2022). These shortcomings highlight the urgent need for research on the development of rigorous, culturally responsive, and sustainable SRL interventions, particularly in underrepresented contexts such as the Middle East. The present study is guided by the following research questions:

1. Does a participation in an AI-based lesson planning intervention lead to a significant improvement in students' overall academic performance?
2. Does use of an AI-based lesson planning platform have a differential impact on the four sub-dimensions of SRL?

3. Literature Review

3.1 AI in Teacher Education

Research on the role of AI in teacher education has grown rapidly alongside the development of AI-powered technologies to support various aspects of teachers' professional development, such as automated feedback on instructional practices, virtual reality for developing class management skills, and AI tutoring systems for improving content knowledge (Cruz et al., 2024). Generative AI has created new possibilities for developing personalised and adaptive learning frameworks that efficiently enhance SRL (Prasad & Sane, 2024). A key area of inquiry is the use of AI for lesson planning. Tools such as ChatGPT have demonstrated significant potential in helping teachers produce well-structured and engaging lesson plans (Van den Berg & Du Plessis, 2023). These tools can empower teachers to brainstorm ideas, integrate activities with curricula goals, and differentiate instruction to address learner diversity (Wong & Viberg, 2024). More research on the impact of these tools is therefore needed, particularly in the context of pre-service teacher education programs (Kehoe, 2023).

3.2 Self-Regulated Learning in Student Teachers

SRL is a multi-dimensional construct involving the ability of learners to formulate goals, monitor their advancement, assess their performance, and request help when needed (Zimmerman, 2008). Recent research has highlighted the importance of evaluating SRL and understanding how AI tools support these processes (Prasad & Sane, 2024). SRL skills enable student teachers to become reflective and committed to their ongoing

advancement (Panadero, 2017) and have been associated with improved teaching effectiveness and professional longevity (Theobald, 2021). The synergy between AI and SRL thus represents a promising opportunity for enhancing educational outcomes (Zhang & Fan, 2025). AI-driven platforms provide adaptive scaffolding, personalised feedback and real-time monitoring to help develop SRL skills. Research has revealed that when AI tools are designed with SRL principles in mind, they can effectively support learners in developing metacognitive awareness and self-regulatory strategies (Wong & Viberg, 2024). Teachers who are effective self-regulated learners are more inclined to establish professional development goals, seek feedback and reflect on their teaching (Zimmerman, 2008). SRL skills can be developed through direct instruction and support (de Ruig et al., 2024), and various methods, such as peer coaching, reflective journals and technological tools, can be used to provide opportunities for student teachers to develop SRL skills that are aligned with their pedagogical competencies (Zee & de Jong, 2024).

3.3 AI and Self-Regulated Learning

The interconnection of AI and SRL is a promising area of research. AI-driven tools have the potential to support SRL by scaffolding complex tasks, providing customised feedback and enhancing self-reflection (Bonilla et al., 2025). For instance, an AI-based platform could be used for lesson planning, providing input on the alignment of the objectives and activities. It could also prompt student teachers to reflect on and enhance their pedagogical choices. By providing such support, AI tools can help student teachers strengthen their self-regulation across their learning and teaching practices (Zhang et al., 2025). However, additional research is needed to understand the best ways of integrating AI tools into teacher education programs to improve student teachers' SRL skills (Mutiga, 2024).

4. Methodology

4.1 Research Design

This study employed a quasi-experimental design to investigate the impact of an AI-driven lesson planning platform. This design enabled the comparison of experimental and control groups, with participants assigned to each group in a manner that ensured comparability. Pre- and post-test measures were used to evaluate changes in SRL skills over time. The participants recruited for this study were 29 student teachers enrolled in the Science Teacher Education program at SQU. They were divided randomly into an experimental group ($n = 14$) and a control group ($n = 15$). Over a four-week period, the experimental group employed the AI-based lesson planning platform for lesson preparation, while the control group utilised traditional lesson planning methods. Prior to the intervention, both groups attended a brief workshop on the Ministry's lesson preparation framework. Both groups were in the final year of the program and had the same teaching experience.

4.2 The AI-Based Lesson Planning Platform

The AI-driven lesson planning platform developed for this research was utilized to support student teachers in creating high-quality lesson plans. The platform delivered a range of features, including:

- **A structured lesson plan template:** The platform integrated all Grade 8, Term 2 learning outcomes from the Teacher's Guide, including content, experiments, activities, and questions from both the Student's Book and the Activity Book, ensuring comprehensive consistency with the official curriculum outlined by the Ministry of Education in Oman.
- **AI-driven suggestions:** The platform, powered by ChatGPT, complied with learning outcomes and official assessment methods. Additionally, it generated suggestions for activities and assessment methods, based on the grade level and subject matter.
- **Feedback and reflection prompts:** The platform provided feedback based on interactions between the student and the system, offering a range of innovative and interactive instructional strategies and assessment methods.
- **Integrated time efficiency:** The platform was designed for efficiency, providing student teachers with instant access to necessary resources with just one click. Participants accessed the platform via laptops and mobile devices, receiving instant AI-generated text feedback to guide lesson design aligned with the Omani science curriculum.

4.3 Data Collection and Analysis

The Self-Regulated Learning (SRL) questionnaire was developed by the researcher based on Zimmerman (2000) and Pintrich (2004). It included 24 items across four dimensions: planning, self-monitoring, quick evaluation, and strategy adjustment. Validated by experts, the scale showed strong reliability ($\alpha = 0.89$; subscales = 0.79–0.87; $r = 0.84$). Sample items included "I plan learning tasks in advance" and "I adjust strategies when facing challenges".

The SRL questionnaire was administered to the experimental and control groups, once at the beginning and once at the end of the intervention period. The data were analysed using SPSS software, performing independent and paired samples t-tests to compare the SRL scores of both groups.

5. Results

5.1 Descriptive Statistics

The descriptive statistics for the pre-test and post-test scores of the experimental and control groups are presented in Table 1.

Table 1: Descriptive statistics for pre-test and post-test SRL scores

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Change
Experimental	14	75.07	10.5	102.0	12.5	+16.93
Control	15	78.8	11.5	85.67	13.0	+6.87

5.2 Pre-Test Group Equivalence

An independent samples t-test was conducted to compare the pre-test SRL scores of the experimental and control groups. The results revealed no statistically significant differences between the two groups at the pre-test assessment ($t(27) = -0.95$, $p = 0.351$). This finding indicates that the SRL skills of the two groups were equivalent at the start of the study, providing a solid foundation for comparing post-intervention outcomes.

5.3 Main Effects of the Intervention

A paired samples t-test was conducted to compare the experimental group's pre-test and post-test SRL scores. The results revealed a statistically significant improvement in the group's SRL performance from pre-test ($M = 75.07$, $SD = 10.5$) to post-test ($M = 102.0$, $SD = 12.5$), $t(13) = -6.93$, $p = 0.005$. The intervention resulted in a substantial mean SRL score increase of 26.93 points, with a confidence interval ranging from -35.5 to 18.3. A paired samples t-test was also conducted to compare the control group's pre- and post-test scores. The results revealed no statistically significant change in the control group's SRL performance from pre-test ($M = 78.8$, $SD = 11.5$) to post-test ($M = 85.67$, $SD = 13.0$), $t(14) = -1.8$, $p = 0.438$, with only a modest mean increase of 6.87 points.

An independent samples t-test was conducted to compare the post-test scores of the experimental and control groups. The results indicated a statistically significant difference between the two groups in terms of their post-test scores ($t(27) = 3.85$, $p = 0.001$), with the experimental group demonstrating superior SRL performance.

Our results suggest that AI-driven platforms may be significantly effective, as our effect size exceeds the average reported in previous meta-analyses. In contrast, the control group showed no significant increase in SRL scores from pre-test ($M = 78.8$, $SD = 11.5$) to post-test ($M = 85.67$, $SD = 13.0$), $t(14) = -1.8$, $p = 0.438$. The mean SRL scores increased by 6.87, with a confidence interval spanning from -15.3 to 1.5. An independent samples t-test was implemented to compare the SRL scores of the experimental and control groups at the post-test assessment. No statistically significant difference was found in the results for either the experimental group ($M = 102.0$, $SD = 12.5$) or the control group ($M = 85.67$, $SD = 13.0$); $t(27) = 1.5$, $p = 0.14$.

The pre-post changes in both groups are illustrated in Figure 1, which clearly demonstrates the contrasting trajectories between the experimental and control groups.

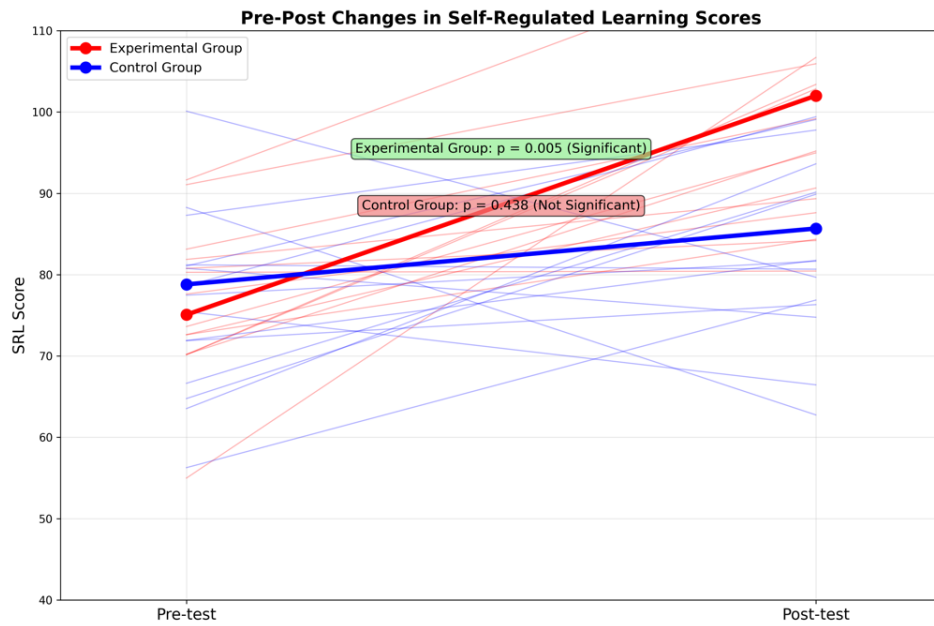


Figure 1: Pre-post changes in self-regulated learning scores showing significant improvement in the experimental group ($p = 0.005$) compared to a non-significant change in the control group ($p = 0.438$). Individual participant trajectories are represented by thin lines, with group means indicated by thick lines.

Figure 2 presents a comprehensive statistical analysis across multiple dimensions, providing a detailed breakdown of the intervention's impact on various aspects of SRL performance.

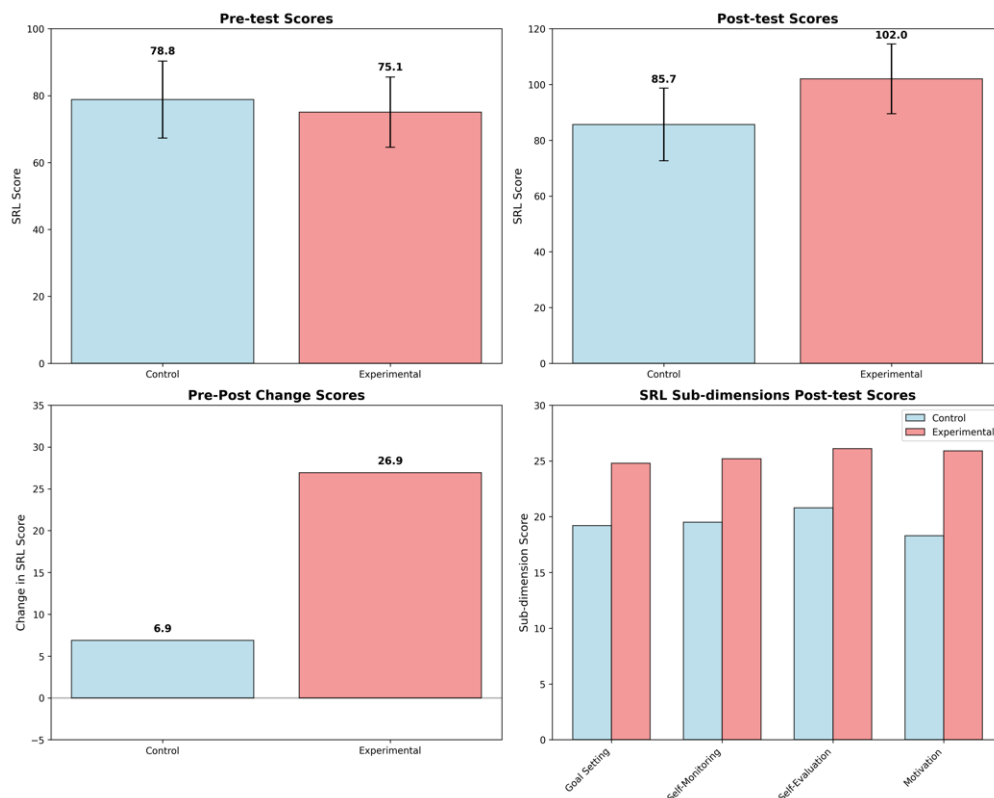


Figure 2: Comprehensive statistical analysis showing (A) pre-test scores, (B) post-test scores, (C) change scores, and (D) sub-dimension analysis. The experimental group demonstrated superior performance across all measures following the AI-powered intervention.

A series of paired samples t-tests was conducted to examine the impact of the intervention on the four sub-dimensions of SRL for the experimental group. The results of the t-tests indicated statistically significant

improvements in all four sub-dimensions from the pre-test to the post-test assessments. These findings support Q2, which predicted that the SRL intervention would lead to substantial improvements in all four SRL sub-dimensions for the experimental group. The distribution patterns and variability of scores across both groups are further illustrated in Figure 3, which demonstrates the consistency of improvement within the experimental group.

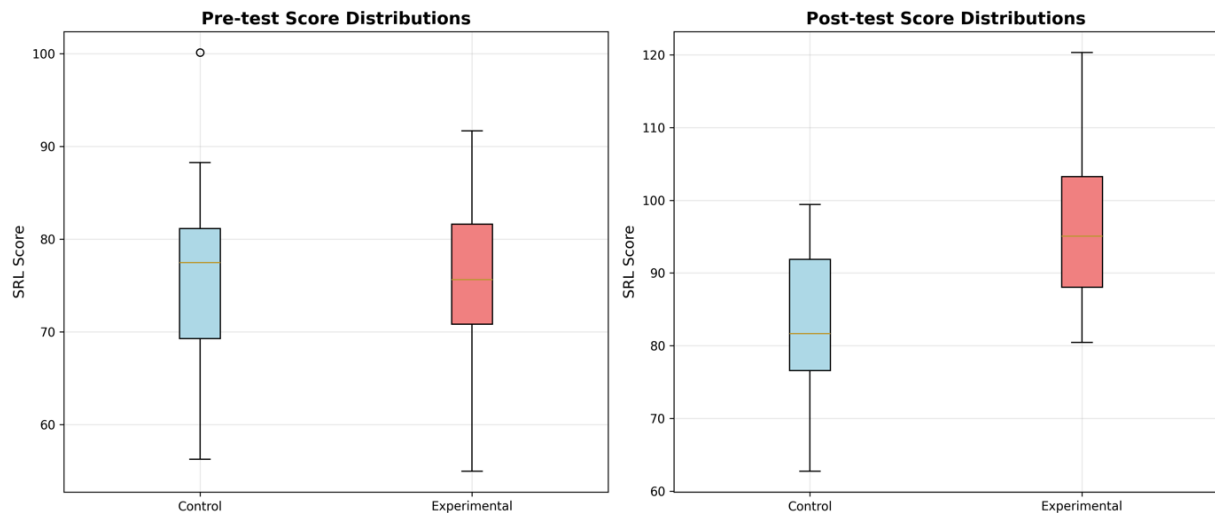


Figure 3: Box plot distributions showing the spread of SRL scores for both groups at pre-test and post-test phases. The experimental group shows higher median scores and reduced variability at post-test, indicating consistent improvement across participants.

6. Discussion

The results of this research provide strong evidence of the impact of the AI-driven lesson planning platform in enhancing self-regulated learning among student teachers at SQU. The statistically significant improvement in the SRL scores of the experimental group, compared to the lack of significant change in the control group, suggests that the AI platform played a crucial role in this improvement. This result is consistent with previous study research emphasising the promise of AI-powered tools in fostering SRL in multiple learning environments (Bonilla et al., 2025; Zhang et al., 2025). The results showed that the experimental group significantly improved across all four sub-dimensions, while the control group showed no significant improvement in any of the sub-dimensions. These results are especially notable as they align with Grueneke & Guggenberger's (2024) multilayer taxonomy of AI-enabled self-regulation, which highlights the effectiveness of AI systems in improving all SRL dimensions. The comprehensive progress in all SRL skills indicates that the AI platform was impactful in promoting SRL development, aligning with Prasad & Sane's (2024) framework for generative AI in personalised education. These results align with a previous study, which indicated that traditional approaches without digital scaffolding exhibit limited effectiveness in developing SRL skills (Wong & Viberg, 2024). However, the practical significance of an observed difference of 16.33 points between groups indicates a meaningful improvement, supporting recent findings on the integrated influence of AI and self-regulation in educational contexts (Zhang, 2016). The fact that the AI platform proved effective across all SRL sub-dimensions suggests that its design provided a comprehensive framework for fostering SRL. The structured template, AI-driven suggestion, feedback and reflection prompts and integrated time efficiency all likely played a role in this positive outcome.

The practical significance of the intervention's results is further demonstrated by the effect size analysis, shown in Figure 4, which illustrates the magnitude of differences between the groups across the study phases.

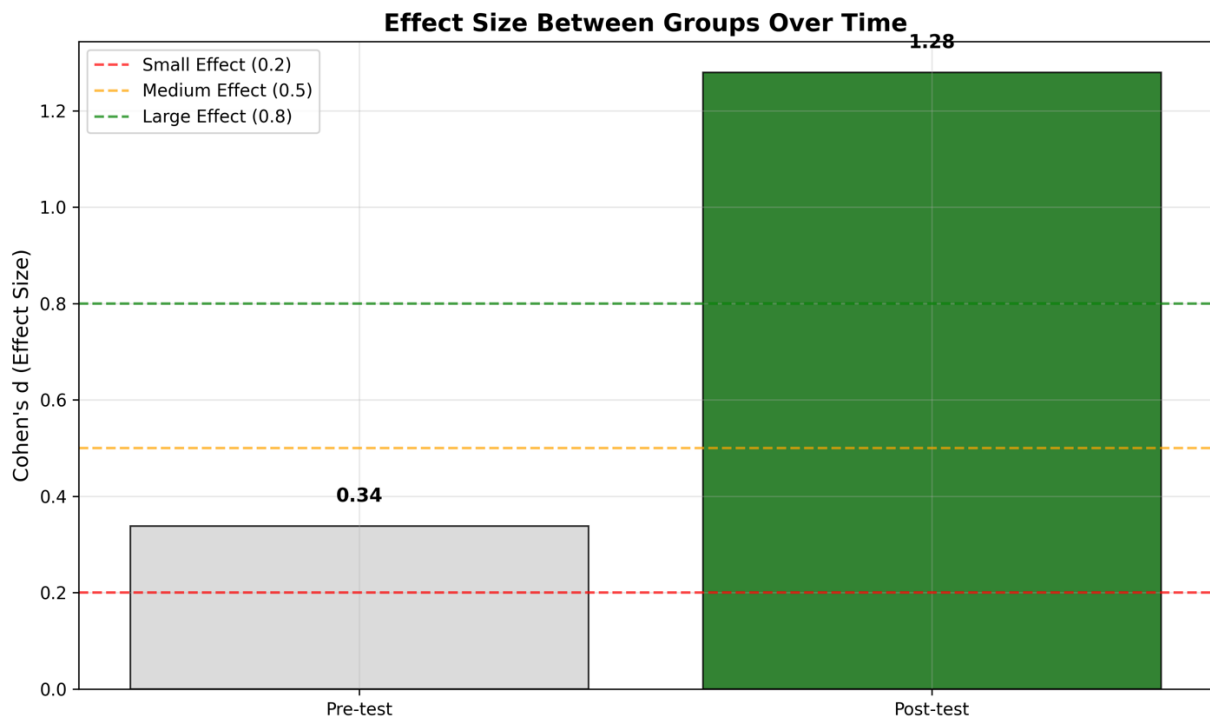


Figure 4: Effect size analysis showing Cohen's d values for both groups at pre-test and post-test phases. The substantial increase in effect size from pre-test to post-test assessments demonstrates the practical significance of the AI-powered intervention.

The main effect, yielding a moderate effect size of Cohen's $d = 0.633$, aligns with Zheng's (2016) meta-analysis, which found that SRL supported by computer-based learning environments results in a significant improvement in academic performance ($ES = 0.438$). The results provide strong evidence for the effectiveness of the AI-powered SRL intervention in teacher education. The experimental group exhibited a significant 26.93-point improvement from pre-test to post-test assessments compared to the modest 6.87-point increase in the control group, confirming the intervention's impact on developing SRL skills. This improvement was statistically significant ($p = 0.005$) and practically meaningful, aligning with emerging research on AI-enhanced education and highlighting the value of integrating AI in teacher preparation programs.

Further comparisons between groups reinforced the superiority of the AI intervention, with post-test results showing significant differences in favour of the experimental group ($p = 0.001$). The effect size analysis confirmed both the statistical and practical significance of the findings, while the observed improvements across all four SRL sub-dimensions demonstrated the comprehensive impact of the intervention. These findings resonate with prior studies on SRL and underscore the methodological strength of using a quasi-experimental design for evaluating AI-supported learning strategies.

Despite these promising results, this study has limitations. The quasi-experimental design without randomisation restricts the ability to make causal claims, the small sample size limits generalisability, and the specific cultural context of SQU may not be representative of other settings. Nevertheless, the implications are significant: integrating explicit SRL instruction and AI-powered tools into teacher preparation programs can strengthen student teachers' autonomy, confidence, and reflective practice. Future research should extend this work with larger, more diverse samples and examine long-term outcomes such as motivation, self-efficacy, and professional development.

7. Conclusion

This research provides critical insights into the potential of AI-driven tools to promote teacher education. The findings suggest that an innovative AI-based lesson planning platform can serve as a powerful tool for advancing SRL among student teachers. The study has significant implications for teacher education programs at SQU, as well as other similar institutions. The integration of AI-powered tools into teacher education programs could promote the growth of competent, self-regulated teachers, ensuring their readiness for 21st-century classroom challenges. Future studies should further explore the promise of AI integration in teacher education programs

to deepen understanding of the long-term impact of AI-powered tools on teacher development and identify the features that are most effective for fostering SRL. It would also be valuable to explore the applications of such AI-based platforms in broader areas of teacher education, including student assessment and classroom management.

Ethics Declaration

This study received ethical approval from the Research Ethics Committee at the College of Education, Sultan Qaboos University (Approval Code: REAAF/EDU/CUTM/25/07). All participants were informed about the purpose and procedures of the study, and their participation was voluntary. Written consent was obtained, and confidentiality and anonymity were assured throughout the research process.

AI Declaration

AI-based tools were used in the preparation of this paper. Consensus supported literature search, ChatGPT assisted in drafting and refining the text and in formatting references according to Harvard style, Elicit helped identify relevant research, and Manus was used to generate charts and figures. All outputs were critically reviewed and verified by the author for accuracy and appropriateness.

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