Enhancing Students' Self-Regulated Learning through Differentiated Instruction Based on Prior Knowledge

Muhammad Idris Hasanuddin[1], Zuhdiah[2], Sukri Badaruddin[3], Aan Setiawan[4], Ummi Kalsum[5]

[1] STAIN Majene, Indonesia; idrishasanuddin@stainmajene.ac.id

[2] STAIN Majene, Indonesia; Zuhdiah@stainmajene.ac.id

[3] STAIN Majene, Indonesia; sukribadaruddin@stainmajene.ac.id

[4] STAIN Majene, Indonesia; aansetiawan@stainmajene.ac.id

[5] STAIN Majene, Indonesia; Ummikalsum0005@gmail.com

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ABSTRACT

Differentiated instruction, which tailors learning experiences based on students' readiness, interests, and prior knowledge, has been identified as an effective approach to fostering self-regulated learning. This study aims to analyze the impact of differentiated instruction based on prior knowledge on students' self-regulated learning, focusing on its benefits, challenges, and potential solutions for effective implementation. A systematic literature review was conducted using major academic databases, applying PRISMA guidelines for article selection. Thematic analysis was employed to identify key themes related to prior knowledge, differentiated instruction, and self-regulated learning. The findings indicate that differentiated instruction based on prior knowledge positively contributes to the development of students' self-regulated learning, metacognitive skills, self-efficacy, and intrinsic motivation. However, challenges such as limited teacher training, time constraints, and lack of institutional support hinder its implementation. Various strategies, including professional learning communities (PLCs), dynamic assessment, and adaptive technology, have been proposed to address these issues. The study concludes that strengthening teacher training programs, fostering collaboration among educators, and leveraging technology are essential to optimizing the implementation of differentiated instruction based on prior knowledge. Future research should explore its application across different educational levels and subject areas to enhance its effectiveness in diverse learning contexts.

Corresponding Author:

Muhammad Idris Hasanuddin

STAIN Majene, Indonesia; idrishasanuddin@stainmajene.ac.id

1. INTRODUCTION

Self-regulated learning (SLR) has become a critical skill that students must develop in the 21st century, partiicularly in the context of digitalized education and evolving learning paradigms. As educational environments increasingly incorporate technology, students must develop the ability to manage their own learning processes effectively. Digitalization has not only transformed access to information but has also shifted the role of educators from knowledge transmitters to facilitators of learning (Aayendrakumar N. Amin, 2016). This shift requires students to take greater responsibility for their own learning, making SRL a crucial component of academic success. Additionally, the challenges posed by post-pandemic learning environments highlight the necessity for students to adapt to hybrid and remote learning settings, where self-regulation plays a pivotal role in maintaining engagement and performance. Differences in generational learning approaches further complicate this landscape, as today's students often rely on digital resources and self-paced learning methods, necessitating a deeper understanding of how to foster SRL effectively.

Zimmerman defines SRL as a process in which students actively regulate their cognition, motivation, and behavior to achieve predetermined learning goals. Zimmerman's Cyclical Phases of SRL framework further explains this process as consisting of three stages: (1) forethought, where students set goals and plan strategies; (2) performance, where they implement and monitor their learning strategies; and (3) self-reflection, where they evaluate their performance and adjust their approaches accordingly.(Zimmerman, 1990) Despite its importance, research indicates that many students struggle with SRL due to ineffective learning strategies and poor time management (Dignath & Büttner, 2008). Furthermore, the prevalence of teacher-centered instruction in many schools' limits opportunities for students to develop autonomy in learning. This issue became even more pronounced during the COVID-19 pandemic, which necessitated higher levels of self-regulation in remote learning environments but often lacked sufficient scaffolding to support students in developing these skills (Faddlliyah & Gusti, 2023).

Differentiated instruction (DI) has emerged as a promising pedagogical approach to address these challenges. Tomlinson defines differentiated instruction as a teaching strategy that considers students' diverse readiness levels, interests, and learning profiles. By designing personalized learning experiences, educators can optimize student engagement and learning outcomes (Tomlinson, 1999). Research by Valiandes has demonstrated that DI positively influences students' academic performance and motivation, suggesting that tailored instruction can play a key role in fostering SRL (Valiandes, 2015). One of the critical components of DI is students' prior knowledge, which includes their accumulated experiences, attitudes, and conceptual understandings. Prior knowledge serves as the foundation for constructing new knowledge (Idris Hasanuddin, 2020), with Gagné et al. emphasizing that it is the most influential factor in learning, as it provides a conceptual framework for integrating new information (Gagné, Ausubel, & Gagne, 1969). Within the DI framework, leveraging prior knowledge allows educators to design instructional activities that align with students' comprehension levels, facilitating deeper learning. Shalikhah and Nugroho found that incorporating prior knowledge into instruction enhances conceptual understanding and higher-order thinking skills, further underscoring its role in effective learning (Shalikhah & Nugroho, 2023).

Despite existing studies on DI, prior knowledge, and SRL, there remains a significant gap in research exploring the interconnections among these three constructs. While numerous studies have examined these aspects independently, few have investigated how DI based on prior knowledge can specifically enhance SRL. Existing literature has yet to provide a comprehensive analysis of how differentiated instruction can be strategically designed to foster various aspects of SRL, such as metacognitive regulation, intrinsic motivation, and effective learning strategies. Additionally,

Cognitive Load Theory (Sweller, Ayres, & Kalyuga, 2011) suggests that prior knowledge influences cognitive processing capacity, yet little research has examined how this concept interacts with DI to support SRL development. Addressing this gap is critical in ensuring that differentiated instruction is implemented effectively to enhance self-regulated learning skills.

To bridge this research gap, this study aims to analyze the role of differentiated instruction based on prior knowledge in enhancing students' self-regulated learning. Specifically, the study seeks to answer the following research questions: (1) what are the role of prior knowledge in differentiated instruction? (2) What are the impacts of differentiated instruction on students' ability to manage their learning processes independently? 3) What challenges do educators face in implementing differentiated instruction to foster SRL, and what are potential solutions?

Through a comprehensive literature review, this study aims to provide deeper insights into how teachers can effectively utilize students' prior knowledge to implement differentiated instruction that fosters self-regulated learning. Furthermore, the findings of this study may serve as a valuable reference for educators in developing adaptive instructional strategies that cater to the diverse needs of students.

2. METHODS

This study employs a systematic literature review (SLR) approach to analyze the relationship between differentiated instruction based on prior knowledge and students' self-regulated learning. The SLR method was chosen due to its ability to synthesize existing research findings comprehensively, providing a broader theoretical foundation for understanding the interconnections among these constructs (Hart, 2018). Given the diverse methodologies used in prior research and the challenges in accessing field data, SLR enables a structured analysis of relevant studies while ensuring methodological rigor. Additionally, SLR allows for the identification of research gaps and patterns that experimental or meta-analytical studies might not fully capture.

Literature was gathered from major academic databases, including Scopus, Web of Science, ERIC, and Google Scholar, as well as the ProQuest dissertation repository. A keyword search was conducted using Boolean operators (AND, OR, NOT) in both Indonesian and English to ensure comprehensive coverage. The search terms included combinations of "differentiated instruction," "prior knowledge," and "self-regulated learning."

Articles were selected based on the following inclusion criteria: publication in peer-reviewed journals or reputable conferences between 2010 and 2024, empirical or theoretical studies explicitly addressing the relationship among differentiated instruction, prior knowledge, and self-regulated learning, and studies written in English or Indonesian. Exclusion criteria included non-peer-reviewed sources, opinion papers, and studies that did not examine all three core constructs.

The selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Tricco et al., 2018). The process included four stages: (1) Identification, where 1,230 articles were retrieved; (2) Screening, where 720 articles were removed after title and abstract review; (3) Eligibility, where 180 studies were excluded due to irrelevance or methodological issues; and (4) Inclusion, where 80 articles were finalized for analysis. To ensure reliability, two independent researchers conducted the screening process, achieving an inter-rater agreement of 85%.

Data analysis was conducted using the thematic analysis method developed by Braun and Clarke, encompassing six stages: (1) data familiarization, (2) initial coding, (3) theme identification, (4) theme review, (5) theme definition and naming, and (6) final synthesis (Braun & Clarke, 2006). To enhance the reliability of the thematic analysis, NVivo software was used for coding and theme identification. The key findings were categorized into three main aspects: (1) The role of prior knowledge in differentiated instruction. (2) The impact of differentiated instruction based on prior knowledge on self-regulated learning. (3) Effective implementation strategies. This structured approach facilitates the identification

of patterns and relationships among these concepts, providing a deeper understanding of how differentiated instruction based on prior knowledge can enhance students' self-regulated learning.

3. FINDINGS AND DISCUSSION

The Role of Prior Knowledge in Differentiated Instruction

A review of the literature on prior knowledge and differentiated instruction reveals several key findings that highlight the relationship between these concepts. Prior knowledge plays a strategic role in differentiated instruction, as it significantly contributes to students' academic performance.(Dochy, Segers, & Buehl, 1999) This underscores the importance of identifying and integrating students' prior knowledge when designing instructional strategies. A study by van Kesteren and Meeter demonstrated that prior knowledge serves as a conceptual framework that facilitates students' ability to process and integrate new information.(van Kesteren & Meeter, 2020) From a cognitive perspective, new information that aligns with pre-existing knowledge is more easily processed and retained in long-term memory. These findings align with Sweller et al.'s Cognitive Load Theory, which asserts that instructional designs incorporating prior knowledge reduce students' cognitive load, enabling them to focus more effectively on complex learning tasks.(Sweller et al., 2011)

In the context of differentiated instruction, Park and Datnow identified three key approaches that teachers employ to accommodate students' prior knowledge: (1) pre-assessment to determine students' existing knowledge, (2) flexible grouping based on knowledge levels, and (3) tiered activities tailored to students' comprehension levels.(Park & Datnow, 2017) Experimental research by Subban and Round further supports the notion that differentiated instruction that considers students' prior knowledge leads to significant improvements in conceptual understanding, particularly in complex subjects (Subban & Round, 2015).

A study conducted by Syeda in secondary schools found that pre-assessment provides valuable insights for teachers in designing appropriate instructional activities, playing a crucial role in identifying students' knowledge gaps and enabling more effective differentiated instruction. Consequently, pre-assessment is recommended as a primary diagnostic tool in responsive and inclusive instructional design (Syeda Saima Ferheen, 2019). Supporting this, a meta-analysis by Deunk et al. of 30 experimental studies on differentiated instruction in primary schools revealed that explicitly incorporating students' prior knowledge in differentiated instruction resulted in a significantly larger effect size (d = 0.72) compared to approaches based solely on student interests or learning styles (d = 0.35) (Deunk, Smale-Jacobse, de Boer, Doolaard, & Bosker, 2018). These findings collectively emphasize the critical role of prior knowledge assessment in optimizing instructional strategies and student learning outcomes.

The Impact of Differentiated Instruction on Self-Regulated Learning

Empirical studies consistently support the effectiveness of differentiated instruction in fostering students' self-regulated learning. A longitudinal study by Whittle et al. found that differentiated instruction significantly contributes to the development of students' self-regulation, particularly in goal setting, self-monitoring, and self-evaluation.(Whittle, Benson, Orcutt, & Weinstein, 2021)

In the framework of Self-Determination Theory, Ryan and Edward found that differentiated instruction based on prior knowledge enhances students' intrinsic motivation by aligning learning experiences with their level of competence.(Ryan & Edward L., 2000) When students perceive themselves as competent and autonomous learners, they are more likely to develop self-regulation skills. These findings are further supported by Vansteenkiste et al. (2010), who demonstrated a strong positive correlation (r = 0.68, p < 0.01) between learning experiences that fulfill students' basic needs—

competence, autonomy, and relatedness—and the development of self-regulated learning.(Vansteenkiste, Niemiec, & Soenens, 2010)

An experimental study conducted by Kompurrini et al. in Indonesia involving 128 middle school students demonstrated that differentiated instruction based on prior knowledge significantly improved self-regulated learning compared to conventional instruction (t = 4.85, p < 0.001). The experimental group exhibited enhanced learning planning, progress monitoring, and cognitive strategy application (Kompurrini, Murniarti, & Hotmaulina, 2021). Similarly, a qualitative study by Widiana underscored the crucial role of metacognitive awareness in self-regulated learning, highlighting that students with well-developed metacognitive skills can identify their strengths and weaknesses and adopt effective learning strategies. Metacognition was found to be a stronger predictor of academic achievement than demographic factors, prior knowledge, teacher-student interactions, or socioeconomic status. This reinforces the notion that differentiated instruction based on prior knowledge contributes to the development of metacognitive awareness (Widiana, 2022).

Further supporting these findings, a mixed-method study by Valiandes and Tarman identified four key mechanisms through which differentiated instruction fosters self-regulated learning: enhancing self-efficacy through personalized learning experiences, developing metacognitive skills via structured reflection, increasing intrinsic motivation by offering meaningful learning choices, and promoting effective learning strategies through appropriate scaffolding, including ICT tools. These mechanisms highlight the multifaceted benefits of differentiated instruction, particularly in fostering student autonomy and motivation (Valiande & Tarman, 2011).

Moreover, a meta-analytic study by Safawi and Akay examined 23 studies conducted in Turkey between 2010 and 2021 and found that differentiated instruction had a moderate effect on academic achievement (0.791) and a small effect on student attitudes (0.359). The experimental group consistently outperformed the control group, with longer intervention durations further amplifying its effectiveness, particularly in shaping student attitudes. These findings suggest that differentiated instruction should be integrated across all education levels, from primary to higher education, given its superior impact compared to traditional teaching methods. Additionally, further research is warranted at the secondary and tertiary levels, particularly in the social sciences, where empirical studies on differentiated instruction remain scarce (Safawi & Akay, 2022).

The collective findings from these studies underscore the substantial benefits of differentiated instruction in enhancing self-regulated learning, metacognitive awareness, and academic performance. Differentiated instruction not only improves students' ability to plan, monitor, and regulate their learning but also fosters self-efficacy and intrinsic motivation through tailored instructional approaches. While its effectiveness is well-documented across various educational contexts, the need for further research, particularly in secondary and tertiary education and in the social sciences, remains crucial for expanding its applicability and optimizing instructional practices.

Challenges and Solutions in Differentiated Instruction Implementation

Although differentiated instruction based on prior knowledge has proven effective in enhancing self-regulated learning, its implementation presents several challenges. A study by Gibbs examining Australian secondary schools identified three major barriers: teachers' difficulties in implementing differentiated instruction, the limitations of school leadership in supporting its application, and gaps in teacher preparation from pre-service to in-service training. These findings suggest that despite widespread recognition of differentiated instruction's importance in addressing student diversity, its execution is often hindered by both internal and external factors. To overcome these challenges, the study recommends increasing professional development opportunities, fostering collaboration among

educators, and strengthening administrative support to enhance the sustainability and effectiveness of differentiated instruction (Gibbs, 2023).

Similarly, a mixed-method study by Valiandes and Loizos identified four key mechanisms through which differentiated instruction fosters self-regulated learning: enhancing self-efficacy through differentiated success experiences, developing metacognitive skills via structured reflection, boosting intrinsic motivation through meaningful activity choices, and encouraging effective learning strategies through appropriate scaffolding. These mechanisms illustrate how differentiated instruction can contribute to student autonomy and deeper learning engagement. However, effective implementation requires structured teacher training and institutional support, particularly in ensuring that differentiation strategies are consistently applied across diverse classroom settings (Valiandes & Loizos, 2019).

In the Indonesian context, a qualitative study by Suprayogi et al. found that the adoption of differentiated instruction in primary schools remained relatively low compared to mastery learning standards. Key challenges included time constraints, insufficient professional training, and limited parental and institutional support. Additionally, many teachers relied on generic teaching strategies rather than structured differentiation approaches such as peer tutoring and project-based learning (Suprayogi & Valcke, 2016). A subsequent study by Suprayogi, Valcke, and Godwin further emphasized that teachers' adoption of differentiated instruction is influenced by multiple interrelated factors, including self-efficacy, teaching beliefs, years of experience, professional development opportunities, certification, and class size. While the overall implementation level was relatively high, it remained below critical benchmarks, underscoring the need for systemic improvements in training and policy support to maximize the impact of differentiated instruction (Suprayogi, Valcke, & Godwin, 2017).

To address the challenges associated with implementing differentiated instruction, various solutions have been proposed and tested in the literature. De Neve et al. developed a sustainable professional development model incorporating case-based workshops, mentorship programs, and professional learning communities (PLCs). This model has proven effective in enhancing teachers' ability to implement differentiated instruction by fostering collaboration and reflective teaching practices (De Neve, Devos, & Tuytens, 2015). Similarly, Firmanto et al. found that collaborative lesson planning among teachers significantly reduced individual workload and improved the quality of instructional materials. By working together within subject groups, teachers could develop differentiated learning materials that could be adapted based on their students' diverse needs (Firmanto, Rahayu, & Lestari, 2015).

Assessing students' prior knowledge is a crucial component of effective differentiated instruction. Kalyuga and Sweller introduced dynamic assessment as an alternative to traditional pre-assessment methods (Kalyuga & Sweller, 2005). This approach enables real-time identification of students' knowledge levels, allowing teachers to make immediate instructional adjustments. The effectiveness of dynamic assessment is further supported by adaptive learning technologies, which automatically adjust material levels based on student responses (Kalyuga, 2012). Additionally, Yahya et al. demonstrated how technology-based learning platforms facilitate differentiated instruction by enabling automated pre-assessment, personalized content delivery, and real-time student progress monitoring (Yahya, Suryani, & Hermansyah, H., & Nurhairunnisah, 2024). These findings highlight the potential of digital platforms to enhance instructional efficiency, particularly in large classrooms.

One of the primary challenges in differentiated instruction is designing instructional activities that cater to diverse student needs. Dixon et al. emphasized that a strategy effective for one student may not work for another, making differentiation essential. To address this, they developed a framework for efficient planning, including lesson planning templates, differentiated activity banks, and rotational

learning systems. This framework significantly reduced teachers' preparation time (from five hours to two hours per week) while maintaining instructional quality (Dixon, Yssel, McConnell, & Hardin, 2014). Similarly, Tucker proposed station rotation and blended learning as effective strategies for large classrooms (Tucker, 2022). These approaches allow teachers to provide personalized instruction to small groups while other students engage in independent or technology-assisted learning. Studies have shown that this method is effective even in classrooms with up to 40 students (Larsari, Dhuli, & Chenari, 2023).

Despite these advancements, the implementation of differentiated instruction still faces obstacles such as time limitations, inadequate professional development, and limited support from parents and educational institutions. Research has identified three primary barriers: teachers' difficulties in adapting materials to students' needs, insufficient school leadership support, and gaps in teacher training from pre-service to in-service teaching. To address these issues, strategies such as professional learning communities, dynamic assessment, and technology-enhanced instructional approaches (e.g., station rotation and blended learning) have been developed. Furthermore, adaptive digital platforms offer promising solutions for improving the efficiency of differentiated instruction, particularly in large classroom settings.

Differentiated instruction based on prior knowledge has been widely recognized as an effective approach to enhancing student learning outcomes, yet its implementation remains challenging. Research highlights various strategies to address these challenges, including collaborative lesson planning, professional learning communities, dynamic assessment, and adaptive digital platforms. Technology-enhanced instructional approaches, such as blended learning and station rotation, have also proven effective in large classrooms. Moving forward, ensuring the sustainability and effectiveness of differentiated instruction requires ongoing investment in teacher professional development, fostering collaboration among educators, and integrating advanced learning technologies. By addressing these barriers, differentiated instruction can be more effectively implemented across diverse educational contexts, ultimately improving learning experiences and outcomes for all students.

4. CONCLUSION

This study highlights the significant role of prior knowledge in differentiated instruction, emphasizing that it serves as a foundation for personalized learning experiences. Prior knowledge helps educators tailor instruction to students' individual needs, enhancing engagement and comprehension. When effectively utilized, it fosters meaningful connections between new and existing knowledge, allowing students to progress at their own pace while developing self-regulated learning (SRL) skills.

The findings also indicate that differentiated instruction positively impacts students' ability to manage their learning processes independently. By providing varied instructional strategies, scaffolding, and choice, students gain autonomy, motivation, and metacognitive awareness, which are crucial for SRL. Personalized learning pathways empower students to take ownership of their learning, improving their ability to set goals, monitor progress, and apply self-corrective strategies.

Despite its benefits, implementing differentiated instruction to foster SRL presents several challenges for educators. These include limited time for planning and executing personalized strategies, the need for professional development, and the difficulty of managing diverse learning needs within a single classroom. Potential solutions include integrating technology to streamline differentiation, promoting collaborative professional learning communities, and providing institutional support through policies that encourage flexible instruction.

Future research should explore the long-term impact of differentiated instruction on students' SRL development across different educational levels and subject areas. Additionally, investigating effective

professional development models for educators and the role of digital learning tools in supporting differentiation can further advance the implementation of SRL-focused instructional practices.

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