Effectiveness of a Differentiated Learning Model Based on the Cambridge Curriculum on Self-Regulated Learning Ability and Mathematics Achievement

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Abstract

This study aims to analyze the implementation of a differentiated learning model based on the Cambridge Curriculum and its impact on students' Self-Regulated Learning (SRL) skills and mathematics learning achievement. The research employed a mixed-methods approach with an embedded experimental design, in which qualitative data were collected simultaneously to obtain a comprehensive understanding of the model's effectiveness. The research subjects were Cambridge Lower Secondary students at a private school in Indonesia that implements the Cambridge Curriculum. The instruments used included a mathematics achievement test, an SRL questionnaire, and an observation checklist of learning activities.

The results indicate that the implementation of differentiated learning significantly improved students' learning outcomes compared to conventional instruction, particularly in problem-solving skills and understanding of basic mathematical concepts. In addition, there was an improvement in students' self-regulation abilities, including goal setting, selection of learning strategies, and self-reflection. It can be concluded that the integration of differentiated learning with the Cambridge Curriculum is effective in enhancing student engagement, learner autonomy, and academic achievement in mathematics learning.

Keywords: Cambridge Curriculum, Differentiate Learning, Learning Outcomes, Self-Regulated Learning

Introduction

Mathematics is a structured discipline in which concepts are hierarchically interconnected, requiring students to master foundational knowledge in order to solve various problems. The active roles of both students and teachers are crucial in making learning more meaningful. In the era of Society 5.0, education is expected to move beyond uniform teaching methods toward learning models that provide flexibility and encourage students to take an active role in constructing knowledge according to their interests, readiness and learning profiles. One such approach is differentiated learning.

Differentiated learning is a teaching strategy that aims to adjust the learning process to the needs, interests, and abilities of individual students. Previous studies have shown that differentiated instruction ca improve learning outcomes and student engagement, particularly when learners are provided opportunities that align with their readiness levels and learning styles (Parsons et al., 2013; Valiandes & Neophytou, 2018). In mathematics learning, this approach can enhance student engagement and interaction (Mercy & Zachariah, 2014).

However, its implementation presents challenges, especially in mathematics, where concept are sequential and cumulative. Without careful planning, differentiation may widen learning gaps rather than reduce them (Jacobse & Harskamp, 2012). Therefore, teachers must ensure that students truly understand foundational concepts before progressing to subsequent stages. Although not easy to implement, differentiated learning remains a beneficial approach for improving the quality of learning across various subjects.

Different learning models are designed to tailor educational experiences to meet diverse student needs by adjusting learning content, processes, and products. This approach enhances student engagement and learning outcomes by recognizing individual differences in readiness, interests, and learning profiles. In the context of the Cambridge Curriculum, learning is directed not only toward academic achievement but also toward the development of critical thinking skills, problem-solving abilities, and learner independence. Therefore, process differentiation becomes essential to ensure that each student can actively participate according to their readiness level, learning style, and interests. In this study, process differentiation is implemented by grouping students based on their achievement levels while maintaining the same learning objectives, resulting in different learning processes according to students' abilities. Teachers also provide additional support for students with lower abilities. Process differentiation is further reflected in time management, where students with slower learning speeds are given additional time and reinforcement of basic concepts, while faster learners are encouraged to engage in further exploration or solve higher-level problems.

In Indonesia, differentiated learning has increasingly been explored alongside curriculum innovation, including the adoption of international curricula such as the Cambridge Curriculum. The Cambridge Curriculum is implemented in a growing number of Indonesian schools and emphasizes conceptual understanding, critical thinking, problem problem solving, and communication skills. Integrated with national education standards, it aims to prepare students fro global competencies while maintaining contextual relevance (Wiwik, 2023). In addition, the implementation of a Cambridge based curriculum can serve as an active and enjoyable learning method to engage students and improve subject mastery with differentiated instruction.

The Cambridge Curriculum for the junior secondary level is known as Cambridge Lower Secondary and is designed for students aged 11 to 14 years. This curriculum provides flexibility instructional design while promoting learner attributes such as confidence, responsibility, and encourages students to actively engage in problem solving and reasoning.

When combine with differentiated learning, this curriculum offers opportunities to tailor learning processes, such as grouping strategy, pacing, and levels of task complexity while maintaining consistent learning objectives.

An essential component supporting differentiated learning within the Cambridge Curriculum is Self-Regulated Learning (SRL). SRL refers to students' ability to plan, monitor, and evaluate their own learning through the phases of forethought, performance, and self - reflection. Research has consistently shown that SRL is positively associated with academic achievement, particularly in mathematics, as it promotes goal setting, strategic learning, and reflective thinking (Callan & Cleary, 2019; Fauzi & Widjajanti, 2018). Nevertheless not all students naturally develop strong SRL skills, and limited engagement in monitoring or reflection can hinder learning outcomes (Callan & Cleary, 2019). Therefore, instructional models that internationally foster SRL are needed.

Although prior studies have examined differentiated learning, the Cambridge Curriculum, and self-regulated learning separately, research that integrates these three components within mathematics education especially in the Indonesian context remains limited. Few studies have empirically investigated how a differentiated learning model grounded in the Cambridge Curriculum influences both students' self-regulated learning abilities and mathematics achievement simultaneously. This gap highlights the need for research that examines not only learning outcomes but also the learning processes that support student autonomy and engagement.

Therefore, this study aims to investigate the effectiveness of a differentiated learning model based on the Cambridge Curriculum in improving students' self-regulated learning abilities and mathematics learning achievement. Specifically, the study seeks to examine how process differentiation within the Cambridge Curriculum framework supports students' learning regulation and contributes to their mathematics performance.

Method

This study employed a qualitative approach with a case study design to explore the implementation of differentiated learning in a Cambridge mathematics classroom and its impact on students' learning behaviors and learning outcomes. The research was conducted at a private school in Indonesia that implements the Cambridge Lower Secondary Curriculum. Participants were selected using purposive sampling to ensure relevance to the research objectives. The subjects consisted of one Cambridge mathematics teacher and 12 Grade VIII students who were actively involve in the differentiated learning process. Students participant were selected based on their regular attendance, availability across four learning sessions, and willingness to participate in the study.

Students were grouped according to combination of academic ability (high, medium, and low, based on prior mathematics performance) and learning styles (visual, auditory, and kinesthetic), as identified through initial teacher assessments and learning style questionnaires. This grouping was intended to support process differentiation while maintaining the same learning objectives for all students.

Data collection was carried out across four consecutive learning session to capture consistency and variation in the implementation of differentiated learning. Observations were used to examine the implementation of differentiation strategies and student activities in the classroom. Interviews were conducted to explore the experiences of both the teacher and students, while the SRL questionnaire was used to assess students' abilities to regulate and reflect on their learning processes. An analysis of 42 SRL-related statement items, divided into several key aspects, reveals a clear improvement in students' abilities. In the metacognitive aspect before learning (7 items), students demonstrated stronger skills in planning and setting learning goals. During learning (7 items), students were able to actively adjust their learning strategies throughout the learning process. The metacognitive aspect after learning (6 items) indicated progress in students' abilities to reflect on and evaluate their learning outcomes. Documentation, including lesson plans, students worksheets, and learning outcome, was collected to support and contextualize the observational and interview data.

Data analysis was conducted using the Miles and Huberman model, which includes three stages: data reduction, data display, and conclusion drawing. To enhance the credibility and trustworthiness of the findings, triangulation was systematically applied by comparing data across multiple sources (teacher and students) and multiple techniques (observations, interviews, questionnaires, and documentation). Ethical considerations were addressed by obtaining permission from the school, informed consent from the teacher and students, and ensuring participant anonymity and confidentiality throughout the research process. Through these procedures, the study aims to provide a transparent and credible account of the implementation of differentiated learning based on the Cambridge Curriculum in mathematics instruction.

Results and Discussion

The finding of this study indicates that the implementation of differentiated learning in mathematics within Cambridge Curriculum positively influenced students' self-regulated learning and cognitive learning outcomes. Empirical evidence from classroom observations, SRL questionnaire results, and student work demonstrated improvements in students' learning engagement, strategic behavior, and ability to monitor and reflect on their problem-solving processes. Students showed greater independence in completing mathematical tasks and increased responsiveness to instructional activities adapted to their readiness levels. These findings are consistent with previous studies reporting the effectiveness of differentiated instruction in supporting students' regulation and learning performance (Jansen et al., 2018; Marks et al., 2021), while extending the evidence within the context of Cambridge-based mathematics instruction in Indonesia.

Based on the data collection in questionnaire, the measurements showed that students were better able to manage their time, create a more conducive learning environment, and become more persistent in completing complex tasks. Improvements were also observed in students' ability to seek help when facing difficulties, either from teachers or peers, reflecting the development of self-awareness and self-confidence.

Other findings indicate that differentiated learning is effective in fostering various dimensions of SRL, as proposed by Jansen et al., (2018). Improvements across the three metacognitive phases (before, during, and after learning) not only made students more structured learners but also more reflective. This is consistent with Tomlinson's perspective, which emphasizes that process differentiation allows students to engage more deeply and personally with learning materials, thereby sharpening their metacognitive capacity. Enhancements in time management, learning environment management, and persistence indicate that students developed greater self-discipline and resilience (Zimmerman, 2013) Meanwhile, improvements in help-seeking behavior reflect students' growing awareness of their limitations and confidence in addressing them—key characteristics of self-regulated learners.

From an academic perspective, the implementation of differentiated learning contributed substantially to improvements in mathematics learning outcomes. This was evident from the increase in students' average scores from 74 to 84. Students who previously experienced difficulties in topics such as algebra and contextual problem solving showed significant progress. The tailored approach not only enhanced conceptual understanding but also built students' confidence in exploring various problem-solving strategies.

Within the Cambridge Curriculum context, the curriculum's flexibility facilitates the implementation of differentiation aligned with SRL principles. When tasks and challenges are adjusted to students' readiness levels (for example, providing more complex problems for higher-achieving groups and intensive guidance for lower-achieving groups), students experience greater success. These successful learning experiences strengthen students' self-efficacy. In line with SRL theory, Zimmerman, (2002) explains that increased self-efficacy encourages students to become more persistent and proactive in managing their learning. The teacher's role is crucial as a facilitator who connects differentiation with SRL. By providing feedback and guiding students in self-reflection, teachers help students recognize their strengths and areas for development. Positive student perceptions such as feeling that the materials made learning easier and more understandable indicate that a responsive and supportive learning environment serves as a foundation for developing learner autonomy and sustainable academic achievement.

Based on observations of the implementation of the Cambridge Curriculum in mathematics instruction, the main content areas covered included geometry and measurement, statistics and probability, algebra, and number. Geometry problems, particularly those requiring higher-order thinking skills, were identified as the most challenging for students. These difficulties stemmed not only from the conceptual complexity of geometry but also from the precision required in numerical calculations. Many students understood geometric concepts theoretically but still made errors in numerical computations that affected their final answers. This phenomenon was especially evident in geometry problems requiring analysis of relationships among three-dimensional shapes, multi-step contextual problem solving, or the application of geometric concepts in non-routine situations. These challenges were addressed through differentiated learning approaches by providing structured practice that emphasized not only conceptual understanding but also procedural accuracy through repeated practice with varied and progressively complex problems (Westbroek et al., 2020).

Beyond the SRL aspects measured through the SOL-QR, in-depth observations during the study revealed notable development in students' time management skills, which were initially a major weakness. In the early phase of implementation, most students showed significant difficulty allocating time effectively when working on complex mathematical problems. They tended to spend excessive time on a single problem or rush through tasks, resulting in suboptimal work. Through structured interventions, including the establishment of a disciplined learning environment and repeated timed practice (drilling), students gradually developed awareness of the importance of time management. The drilling process not only reinforced mathematical concepts but also trained students to be more sensitive to effective time allocation. Over time, this structured practice formed productive habits in which students could more proportionally allocate time to understanding problems, devising solution strategies, and reviewing their answers. This transformation became one of the key factors driving the significant improvement in learning outcomes at the end of the intervention, demonstrating that time management as a component of SRL can be developed through consistent and well-directed instructional practices.

Overall, the implementation of a differentiated learning model within the Cambridge Curriculum consistently demonstrated a significant positive impact on the improvement of students' Self-Regulated Learning and mathematics learning outcomes. This approach, which allows for the adjustment of content, processes, and learning environments to meet individual needs, not only enhanced students' metacognitive skills, time management, and persistence but also substantially increased their average achievement scores from 74 to 84. Research shows that differentiated instruction positively influences students' mathematics achievement and significantly affects their performance in mathematics assessments (Rijal et al., 2025). Furthermore, differentiated learning has been shown to improve overall academic performance and can be adapted to meet individual learning needs (Anggareni & Juandi, 2023; Chen & Chen, 2017; Insorio, 2024), ultimately fostering self-regulation and academic success (Zakiya et al., 2025). These successes, particularly in addressing challenging topics such as geometry and algebra, confirm that differentiated learning is a highly effective strategy for achieving high and sustainable learning outcomes within the Cambridge Curriculum context, as it supports the development of learner autonomy and confidence, consistent with findings that SRL is associated with higher levels of academic achievement and helps address learner diversity while improving mathematics proficiency (Insorio, 2024).

Conclusion and Suggestion

This study shows that the differentiated learning model based on the Cambridge Curriculum creates a more adaptive and student centered mathematics learning process. Process differentiation helps meet students' different learning needs and supports active participation in the classroom. The results indicate an improvement in students' Self- Regulated Learning (SRL), especially in planning, applying learning strategies, and reflecting on their learning. In addition, students' mathematics learning outcomes improved, as seen in better understanding of concepts, increased classroom engagement, and greater confidence in solving problems. These findings suggest that differentiated learning supports both academic achievement and learner independence. Therefore, this model is recommended for mathematics teachers in Cambridge Curriculum schools to develop students' autonomy and active learning.

Teachers are encouraged to apply differentiated learning consistently in mathematics instruction, especially process differentiation, to support students' learning independence. Providing regular feedback and opportunities for reflection can further strengthen students' SRL skills. Schools should support teachers by offering training and collaboration opportunities related to differentiated learning strategies aligned with the Cambridge Curriculum. Future research is suggested to involve more participants, longer implementation periods, or different grade levels. Further studies may also explore the use of technology in differentiated learning to enhance students' self-regulated learning and academic performance.

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