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Exploration of the Implementation of Scaffolding Strategies to Enhance Students' Understanding of Sequences and Series

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Abstract

Mathematics learning is often perceived as difficult due to its abstract nature, particularly in the topic of arithmetic sequences and series. This study aims to explore the implementation of scaffolding strategies in teaching sequences and series and to examine their impact on students' understanding. The research employed a qualitative approach with a case study design involving 22 eleventh-grade social science students from MA Hidatul Islamiyah Bagik Nyaka. Data were collected through observation, interviews, and documentation, and analyzed using the Miles and Huberman model, which includes data reduction, data display, and conclusion drawing. The findings indicate that the application of scaffolding through guiding questions, visual representations, step-by-step exercises, and direct feedback effectively enhances students' conceptual understanding of sequences and series. Students demonstrated improved systematic thinking as well as progress in identifying patterns, understanding formulas, and solving contextual problems. Therefore, scaffolding strategies are proven to be effective in helping students grasp abstract concepts in a more concrete manner. The study recommends that teachers consistently integrate scaffolding, particularly in mathematics learning that requires a high level of conceptual understanding.
Keywords: *scaffolding; sequences and series; students' understanding; mathematics learning; case study*

1. Introduction

Mathematics learning is often perceived as difficult by students due to its abstract nature. explains that students struggle to understand variables because of their inherently abstract conceptual nature (Ruli et al., 2025). This is further emphasized by Julyananda et al., who state that learning difficulties, particularly in arithmetic subjects, are still frequently found in formal schools. (Julyananda et al., 2022). Through the learning process, teachers can stimulate and develop students' potential and talents according to their individual abilities (Munir, 2024). One of the challenging topics is sequences and series, in which students are expected to relate numerical patterns to formulas and apply them in various contexts. These difficulties often hinder conceptual understanding and decrease learning motivation. The topic of sequences and series consists of arithmetic and geometric types. The present study focuses on arithmetic sequences and series.

To facilitate students' understanding in the learning process, educators must carefully determine appropriate learning strategies. As explained by Sanjaya (2008, as cited in (Seknun, 2013)), a learning strategy encompasses the methods or techniques selected by educators to present material effectively

so that students are able to comprehend the lesson and achieve the intended learning objectives. A learning strategy also represents the entire set of activities carried out by teachers to ensure that learning outcomes are achieved (Herlina et al., 2022). Given the abstract nature of sequences and series, learning strategies that merely emphasize procedural knowledge without sufficient conceptual support may be insufficient to address students' learning difficulties.

One instructional approach that is particularly relevant in this context is scaffolding, which refers to the provision of temporary assistance by teachers to support students in completing learning tasks until they are capable of working independently. Bruner, as cited in Maybin et al. (1992), argues that children's cognitive development can be enhanced through guidance from adults or more competent peers, who initially provide external support that is gradually internalized by learners (Maybin et al., 1992). When students consciously master a conceptual system, they can utilize it as a cognitive tool for self-regulation. In this process, scaffolding enables learners to transform external guidance into internalized understanding. Similarly, Vygotsky (1978) emphasizes the importance of scaffolding within the Zone of Proximal Development (ZPD), where learners can achieve higher levels of understanding with appropriate support . Arifin et al. further define scaffolding as verbal or written assistance provided by teachers to students who are not yet able to complete tasks independently (Arifin et al., 2020).

The urgency of this research arises from the persistent gap between instructional practices and students' conceptual understanding of arithmetic sequences and series. Despite the recognized importance of scaffolding in mathematics education, many classroom practices still lack systematic and intentional implementation of scaffolding strategies, particularly in topics that require high levels of abstraction. Previous studies have shown that scaffolding can positively influence students' learning outcomes. For instance, Tazkia and Siswono found that reviewing students' work as a form of scaffolding plays a dominant role in overcoming students' difficulties in critical thinking (Tazkia & Siswono, 2023). Likewise, Borchers et al. reported that although students tend to prefer low-scaffolding systems, high-scaffolding approaches can significantly enhance conceptual understanding, even when students are not yet accustomed to such instructional support (Borchers et al., 2025). However, empirical evidence that specifically explores how scaffolding strategies are implemented in teaching arithmetic sequences and series, particularly in terms of classroom practices and students' learning experiences, remains limited.

Therefore, this study is urgently needed to provide a deeper understanding of how scaffolding strategies are implemented in the teaching of arithmetic sequences and series and how these strategies support students' conceptual understanding. The purpose of this study is to explore the forms and stages of scaffolding employed by teachers during the learning process and to examine their impact on students' understanding of arithmetic sequences and series. By addressing this gap, the study is expected to contribute to the development of more effective instructional strategies in mathematics education, particularly for abstract topics that often challenge students' learning.

2. Method

This study employed a qualitative approach with a case study design. The case study was chosen to obtain an in-depth and comprehensive understanding of a phenomenon occurring within a specific context and time frame, particularly in the learning process of sequences and series (Assyakurrohim et al., 2022). The research subjects consisted of 22 eleventh-grade social science students at MA Hidatul Islamiyah Bagik Nyaka. Data were collected through observation, interviews, and documentation. Observations focused on classroom learning activities, including the teacher's role, student participation, and interactions occurring during the learning process. Semi-structured interviews were conducted with the subject teacher and several selected students to explore their learning experiences and responses to the ongoing instructional process. Documentation was used to support the data, including students' work records, observation sheets, and other relevant supporting documents.

Data analysis was conducted using the interactive model proposed by Miles and Huberman, which consists of three stages: data reduction, data display, and conclusion drawing (Qomaruddin & Sa'diyah, 2024) (Qomaruddin & Sa'diyah, 2024). Data trustworthiness was ensured through source and technique triangulation to maintain the consistency and credibility of the research findings.

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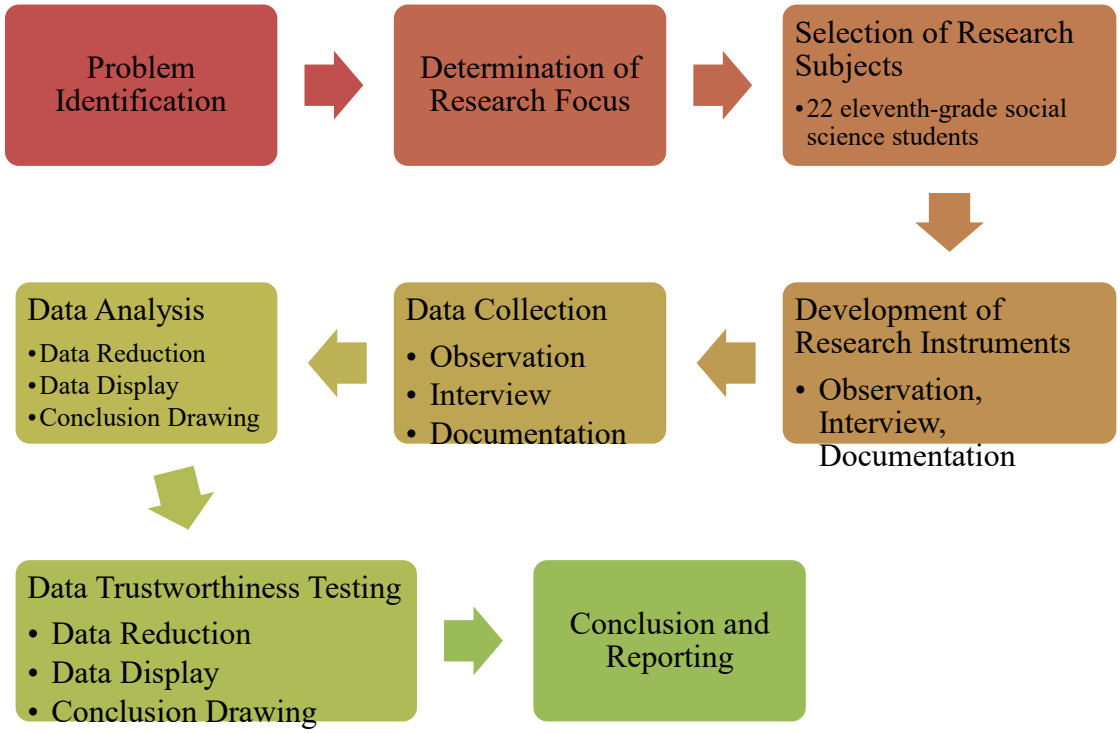

Figure 1. Research flow

3. Results and Discussion

Forms of Scaffolding Implementation

The implementation of scaffolding in the learning of sequences and series was observed through classroom activities, teacher-student interactions, and students' engagement in problem-solving. Based on observations, the teacher applied several forms of scaffolding, including guiding questions, explanations, visual representations, and gradual exercises.

Guiding questions were used to direct students in discovering concepts and patterns independently (Hanifiyah & Rokhmansyah, 2023). These questions aimed to help students identify patterns in sequences and series, fostering active engagement and critical thinking. The teacher's general explanations, combined with illustrative examples, allowed students to construct a foundational understanding of number patterns.

Visual representations such as diagrams, tables, and graphs were also employed to clarify abstract concepts (Cahyaningrum et al., 2023). For instance, the teacher presented a sequence pattern using a table to facilitate comprehension (Figure 1).

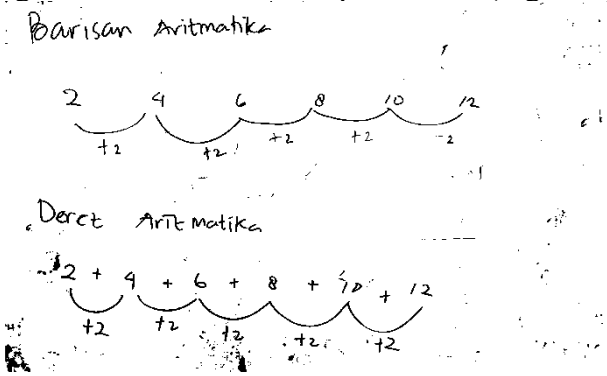

Figure 1. Sequence Pattern

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Gradual assistance was provided by introducing problems progressively, from simple to more complex exercises (Nashihah, 2024). Students' performance on these exercises was documented and analyzed to assess their understanding of sequences and series (Figure 2). The results showed that students could systematically identify patterns, demonstrating effective scaffolding support.

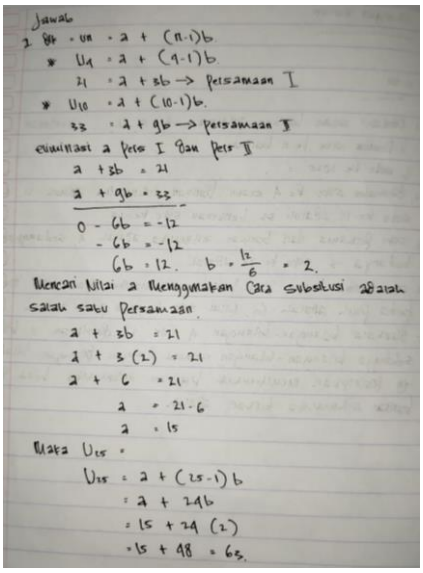

Figure 2. Students' Work Results

This finding aligns with the theoretical definition of scaffolding, which emphasizes guided assistance to help students perform tasks they cannot yet complete independently (Arifin et al., 2020). Immediate feedback during problem-solving allowed students to correct errors and apply systematic strategies, contributing to improved understanding.

Impact on Students' Understanding

Data obtained from interviews and documentation further confirmed the positive impact of scaffolding on students' comprehension. Several students reported that exercises arranged from easy to difficult helped them grasp concepts step by step. For example, one student stated, "The exercises given by the teacher helped us understand the material; we were given problems starting from the easiest to the most difficult ones." Another added, "We were first given easy problems, and for the next problems, we were given the opportunity to answer by referring to the solutions of the easier ones."

Analysis of students' work revealed that scaffolding enabled them to: Quickly identify sequence patterns, Differentiate between arithmetic and geometric sequences, Connect formulas to real-life situations, Solve previously challenging word problems.

These results indicate that the scaffolding strategy, implemented systematically in accordance with the classroom observation, teacher guidance, and progressive exercises, significantly enhanced students' understanding of sequences and series. The alignment between observation, interview, and documentation data demonstrates the consistency and credibility of the findings, as ensured by source and technique triangulation.

4. Conclusion

Based on the findings and discussion presented, it can be concluded that the implementation of the scaffolding strategy in mathematics learning, particularly in the topic of arithmetic sequences and series, significantly enhances students' conceptual understanding. Through the application of various forms of scaffolding—such as guiding questions, visual representations, gradual exercises, and direct feedback—students demonstrated positive development in their systematic thinking processes, their

ability to identify numerical patterns, understand formulas, and solve contextual problems more effectively.

The learning process designed with scaffolding provides students with opportunities to learn gradually—from teacher guidance toward independent learning. The gradual support provided has proven effective in helping students overcome difficulties in understanding abstract concepts by making them more concrete. Furthermore, students' active engagement in the learning process has also increased, as they are given the opportunity to think, experiment, and reflect on their learning outcomes independently, with the teacher acting as a facilitator.

Thus, the scaffolding strategy can be regarded as an effective and relevant instructional approach for enhancing students' conceptual understanding of abstract mathematical concepts. Therefore, it is recommended that mathematics teachers implement the scaffolding strategy consistently and systematically in their teaching practices, particularly for topics that require logical reasoning and higher-order conceptual understanding, such as sequences and series.

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