DEVELOPMENT OF LEARNING TOOLS WITH A SELF ORGANIZED LEARNING ENVIRONMENT MODEL TO FACILITATE STUDENTS' ACADEMIC ABILITIES

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Abstrak
Tujuan dari penelitian ini adalah untuk mengetahui seberapa baik sumber belajar yang menggunakan paradigma SOLE (self-organized learning environment) dalam mendukung pengembangan kemampuan komunikasi matematis siswa. Metode penelitian dan pengembangan adalah pendekatan yang akan diterapkan dalam penelitian ini. Model 4D yaitu define, design, develop, dan disseminate merupakan paradigma pengembangan yang digunakan. Pengambilan data uji coba perangkat pembelajaran dari 100 siswa. Metode analisis deskriptif kuantitatif dan kualitatif digunakan dalam analisis data penelitian ini. Dalam penelitian ini, observasi berfungsi sebagai semacam analisis kualitatif. Berdasarkan penilaian para ahli, model pembelajaran SOLE (self-organized learning environment) dianggap valid sebagai hasil penelitian dan pengembangan yang dilakukan. Nilai rata-rata lebih dari 90 menunjukkan bahwa kinerja siswa telah mencapai KKM, yang menunjukkan keefektifan sumber belajar yang dibuat.
Kata kunci: Perangkat Pembelajaran, Model SOLE (Self Organized Learning Environment), Siswa

Abstract
The purpose of this study is to determine how well learning resources that employ the SOLE (self-organized learning environment) paradigm support students' development of mathematical communication abilities. The research and development method are the approach that will be applied in this study. The 4D model define, design, develop, and disseminate is the development paradigm that is employed. Retrieval of trial data for learning devices from 100 pupils. Both quantitative and qualitative descriptive analysis methods were employed in this study's data analysis. In this study, observations serve as a sort of qualitative analysis. Based on expert assessment, the SOLE (self-organized learning environment) learning model was deemed valid as a result of the research and development conducted. The average score of more than 90 indicates that the student's performance has attained the KKM, demonstrating the efficacy of the learning resources created.
Keywords: Learning Tools, SOLE Model (Self Organized Learning Environment), Students

INTRODUCTION

The capacity to use these symbols to communicate mathematical ideas and opinions to friends, teachers, and other people both orally and in writing is known as mathematical communication abilities. One of the most crucial aspects of learning mathematics is the ability of students to communicate mathematical ideas. This is due to the fact that this skill is required to comprehend accurate mathematical concepts (Rachmad et al., 2023). The significance of mathematical communication abilities stems from the fact that it is a vital part of studying mathematics and a means of idea exchange and clarification of mathematical concepts. The National Education Standards Agency (BNSP) for mathematics learning has content standards that include the ability of students to communicate ideas using symbols, tables, diagrams, or other media to clarify a situation or problem. These standards also emphasize the significance of mathematical communication skills. This aligns with the learning objectives as well, which state that students should be able to effectively and clearly convey mathematical concepts (Parinussa et al., 2023).

There are two significant reasons that communication skills are the focus of learning, namely that they are essentially a language for learning mathematics. In addition to being a thinking tool that aids in problem solving, mathematics is an important learning tool for conveying different ideas carefully, accurately, and concisely. Teaching and studying mathematics involves at least two people working together, namely students and teachers. Students should communicate their ideas and thoughts to others during the learning process because learning is fundamentally a process of exchanging experiences and ideas (Astuti et al., 2023). This view holds that mathematical communication skills are critical competencies that students must possess in order to learn mathematics, both verbally and in writing. One of the most crucial skills in the twenty-first century is the ability to communicate mathematical ideas. Mathematical communication skills can help students expand their thinking, gather knowledge, develop problem-solving and reasoning abilities, develop student independence, and improve students' social skills (Nugroho et al., 2023).

Student communication can be used to explore and strengthen thinking, as well as knowledge and improvement in problem solving. In this case, communication is focused on the basics of effective communication, namely speaking, writing, and reading as social requirements. In addition, mastering mathematics necessitates having the capacity to interpret, define, and convey ideas and concepts represented through variables, diagrams, graphs, and pictures. Engaging in educational activities is a highly efficient approach to instruct, cultivate, and enhance students' communication abilities while also fostering positive relationships between students and instructors. Communication skills are therefore crucial to learning mathematics because they enable students to explain ideas in writing, clarify the outcomes of written expressions of ideas, define material concepts, and facilitate problem-solving (Ramli et al., 2023). The ability to read, listen, interpret, and evaluate mathematical concepts; discuss mathematical concepts and present compelling hypotheses and arguments; understand values and notation and their role in everyday problems and mathematical development are some indicators of mathematical communication skills. Other indicators include modeling situations using pictures, graphs, and algebraic expressions; expressing and explaining thoughts about mathematical ideas and situations; explaining mathematical ideas and definitions (Ernawati & Afif, 2017).

Given the significance of mathematical communication abilities, students must possess strong mathematical communication abilities. Nonetheless, the researcher's observations led to the conclusion that pupils' mathematical communication abilities need development. Observations include the fact that kids are not actively participating in their education. Few pupils made the effort to respond to questions when they were posed. In addition, even when they don't understand, students don't take the initiative to ask inquiries. Students are still unable to express their opinions or ideas in this situation (Fitriyani, 2021). Because they are unable to discover concepts on their own, students are limited to memorizing formulas. Students often find it difficult when they are given questions that are not the same as the ones the teacher has provided in class. Students are unable to correctly translate story issues into mathematical terms, even when they are solving them. This demonstrates that pupils are unable to build mathematical models. Students are therefore not prepared to work on practice questions that deviate from the provided examples. Students also only depend on teachers, and they tend not to look for other alternative learning sources. Students do not try to find additional information to help their learning process, resulting in students being unable to solve the problems presented (Kamaruddin et al., 2023).

This shows that the learning process is not running effectively, resulting in low student mathematics learning outcomes. The issue of inadequate mathematical communication skills that is, the inability to comprehend and evaluate mathematical concepts or opinions both orally and in writing had not been addressed, according to the researcher's observations. This was demonstrated by students who continued to apply formulas incorrectly, students who were unable to comprehend the topic at hand, and students who were unable to identify mathematical concepts in order to solve the problem (Ichsan et al., 2023). In addition, children who are still unable to interpret and transform common situations into mathematical form demonstrate another indicator that has not been reached, which is the ability to model mathematical occurrences using mathematical symbols. Therefore, it can be said that there is still a need to meet the indications of students' mathematical communication abilities. This is corroborated by earlier research that examined and reported that students' mathematical communication abilities remained low, as evidenced by the test questions, which remained on a scale of $\leq 30\%$, and that they continued to struggle to meet the indicators of mathematical communication ability (Rhamdania, 2021).

In addition, previous research on students' challenges with mathematical communication skills questions showed that some students had trouble understanding the questions' overall format and still had trouble solving them, indicating that they still needed to improve their mathematical communication skills. Learning resources that support students' mathematical communication abilities must be developed in order to address issues that arise during the mathematics learning process. The majority of learning resources are merely copied and pasted, then used mostly for formalities and administrative purposes rather than serving as the primary source material for learning activities (Rachmad et al., 2023). Thus, learning aids do not yet help pupils communicate mathematical ideas. Because of this, developing learning aids is necessary to meet the intended learning goals. In order for learning to occur effectively, learning resources known as learning tools must be ready before instruction begins. Teachers and students employ these resources to carry out the learning process. Because they can act as a teacher's guide during the learning process, learning tools have an impact on how well students learn in teaching and learning activities. The learning process will function methodically with the use of learning instruments, enabling the achievement of the anticipated learning objectives. Previous research demonstrating the design and development of learning aids demonstrated that mathematics communication skills improved by 71% following the use of the tools. Furthermore, the design of the learning tools demonstrates that the criteria for developing learning tools that support students' mathematical communication abilities have been addressed in a legitimate and useful way (Parinussa et al., 2023).

In order to create this educational resource, a learning model that supports students' mathematical communication abilities is required. A form of learning that can give students the chance to actively participate in their education and to explore and uncover their own knowledge. In addition, the learning model needs to give students the chance to share what they have discovered from the issue and then offer comments. All of this is included in the SOLE (self-organized learning environment) learning model, which supports students in experimenting and self-replication. Additionally, the SOLE learning model paradigm teaches educators how to enhance the learning process and establish a cooperative learning environment. The SOLE learning approach is divided into three stages: Big Question, namely, students are given questions by the teacher; Investigation, namely, students' efforts to find solutions; Review, namely, students strengthen and clarify the content of learning material guided by the teacher (Astuti et al., 2023).

The goal of the SOLE learning paradigm is to foster students' self-awareness while fostering their capacity for original thought, analytical problem-solving, and effective communication. Previous studies that looked at how the Padlet-assisted self-organized learning environment (SOLE) learning paradigm affected student learning outcomes in rectilinear motion material provide credence to this. The findings demonstrated a noteworthy impact on students' learning outcomes when it came to the rectilinear motion content. utilizing the paradigm of a self-organized learning environment (Ramli et al., 2023). Aside from that, it demonstrates that classes taught using the Zoom application's self-organized learning environments (SOLE) e-learning model are superior to those taught using the Google Classroom application's SOLE e-learning model.

METHOD

The research and development (R&D) approach will be employed in this study. Several steps in the research and development process need to be completed based on the theories of multiple experts. Thiagarajan's four-stage development model serves as the basis for the one being implemented. The 4D model consists of the following stages: define, design, develop, and distribute. In order to design learning tools utilizing the SOLE (self-organized learning environment) model, information regarding needs is gathered during the defining stage. In order to support students' development of mathematical communication abilities, the planning stage involved creating model learning aids for SOLEs (self-organized learning environments). During the development stage, practitioners and subject matter experts tested and revised the first design outcomes. This phase seeks to create a polished learning tool based on feedback from practitioners or experts as well as test results. The dispersal stage comes after a restricted number of trials and an instrument revision. The development results are currently being disseminated in order to encourage acceptance and usefulness among both individual and group users. Only restricted dissemination was done in this study, i.e., teachers were only given access to the final learning tool product through limited dissemination and promotion. retrieval of trial data for learning devices from 100 pupils. Both quantitative and qualitative descriptive analysis methods were employed in this study's data analysis. In this study, observations serve as a sort of qualitative analysis.

RESULTS AND DISCUSSION

Ninety percent of student responses to learning tools are practical, according to the data processing results of the student responses. Based on the evaluation of the material content's applicability, it has extremely useful characteristics with an 88.00% percentage. These findings suggest that the information is simple to understand. Additionally, the information offered makes sense in the context of daily living. Based on the assessment of the learning instruction aspect, it includes very practical criteria with a percentage of 80%. These results indicate that the instructions provided are complete. Based on the assessment of physical condition aspects, it includes very practical criteria with a percentage of 91%. These results show that the resulting learning device has an attractive and good appearance. Based on the language aspect assessment, it includes very practical criteria with a percentage of 88%. These results show that the language used in the LKS is in accordance with PUEBI and is easy to understand. Based on the assessment of the beneficial aspect of using LKS, it includes very practical criteria with a percentage of 85%. These results show that learning tools can provide several benefits for students. Pupils can accurately respond to the questions posed.

The outcomes of the practice questions that the students completed with indications of their mathematical communication skills are shown below. Pupils can accurately respond to the questions posed. Pupils possess the ability to comprehend existing knowledge and formulate inquiries utilizing mathematical ideas. If students follow the correct procedures, they can solve difficulties. In order to properly construct arguments and clarify their responses, students can examine prior responses. Overall, students have demonstrated a solid understanding of sequence and series based on their work on practice questions that include markers of mathematical communication abilities on the evaluation sheet that was created. This is further supported by the average value of 96 that was found. 92% of students complete their coursework. A large number of students obtained a KKM of greater than 75%, according to the data analysis results. Consequently, the application of the SOLE (self-organized learning environment) learning paradigm has enabled students to communicate mathematical ideas more effectively.

Learning tools are said to be good if the assessment process by experts meets valid criteria. Based on the assessment of the Learning Implementation Plan (RPP) by experts, very good criteria were obtained with an overall percentage of 90%. The results of the validation of student worksheets (LKS) obtained very good criteria, with an overall percentage of 92%. For validation of the evaluation sheet, the criteria were very good, with an overall percentage of 91%. Next, the researchers revised the learning implementation plan (RPP), student worksheets (LKS), and evaluation sheets according to suggestions and comments from experts, then tested them on students. This is comparable to earlier research that found that the average syllabus value was 3.5, which included the very valid category; the average RPP value was 3.7, which included the very valid category; and the average LKPD value was 3.5, which included the valid category. With an average score of 3.3, this research fits into the valid category. Researchers found that students responded strongly to learning tools and received an overall average score of 87% using very practical criteria, demonstrating the applicability of the technologies. Consequently, the learning resources developed as a consequence of this research can be utilized by educators or learners. This is consistent with earlier research that demonstrates the applicability of LKPD, which satisfies the requirement of being extremely practical with an overall percentage of 86%. With an average score of 83, this research demonstrates the usefulness of each element and fits into the practical category. The outcomes attained following the use of learning tools in the process are used to evaluate the effectiveness of those tools. The outcomes demonstrate that, in line with predefined indicators, learning tools can support mathematical communication abilities. Based on computations, the average score for the work completed by the students on the assessment sheet was 97. We can conclude that the learning results of the students meet the designated KKM. The analysis of the learning tool work reveals that the use of learning tools that incorporate the SOLE (self-organized learning environment) paradigm can help students improve their ability to communicate mathematical ideas. This is consistent with other studies that demonstrates that 78.5% of students completed the course, and many of them received a KKM of greater than 75%, indicating that the learning resources created met the necessary effectiveness standards.

The 4D research and development model, which has steps for define, design, develop, and disseminate, was used to create the learning resources created with the SOLE methodology. Initial analysis, student analysis, task analysis, idea analysis, and learning objective formulation are the phases that make up the define stage. Observations collected during the learning process were included in both the original study and the student analysis. Four activities made up the sequence and series content that were discovered in the task analysis. The core competencies (KI) and fundamental competencies (KD) that will be used are analyzed as part of the idea analysis. Learning objectives that pertain to fundamental competencies (KD) are specified in the specification of learning objectives. The media selection, format selection, initial design, and instrument preparation are the stages that make up the design stage. Using a variety of online and print resources, including books and websites, the learning tools were formatted and printed on A4 paper using Microsoft Word and Office. The learning tool is transformed into a learning model with learning phases that is a SOLE (self-organized learning environment) in the learning model. Creating lesson plans, worksheets, and assessment sheets also known as draft 1, based on the selected format is the first step in creating educational resources. Creating assessment questionnaires for expert validation and student response questionnaires for the creation of learning tools are examples of evaluation tools. The development stage is divided into multiple phases, starting with the creation of educational resources and ending with expert validation of those resources. After validation, improvements are made to the learning tools according to the suggestions given until they are suitable for use, and finally, a limited trial is carried out by students. The dissemination stage is carried out by providing lesson plans, worksheets, and evaluation sheets to teachers and by providing worksheets and evaluation sheets to students in hardcopy form.

CONCLUSION

The following are the conclusions drawn from the development and study that has been done: Expert evaluation led to the validity of the SOLE (self-organized learning environment) learning model being declared. It is determined that the SOLE (self-organized learning environment) learning model is beneficial. The average value shows how effective the learning resources that were created were. This indicates that the pupil has attained the KKM in terms of score. The following recommendations are based on the findings of the research and creation of educational resources that use the SOLE (self-organized learning environment) learning model to support students' mathematical communication abilities: According to experts, both teachers and students can use the learning resources developed on the SOLE (self-organized learning environment) learning paradigm. In order to give teachers and students access to a wider variety of learning resources for mathematics instruction, learning tools based on the SOLE (self-organized learning environment) learning model are being developed along with additional mathematical materials and concepts. By doing experimental study, other studies can advance the creation of learning aids based on the SOLE (self-organized learning environment) learning model. This research has certain limitations. Specifically, the defined stage of the study is constrained due to the absence of interview activities. The validity, reliability, and degree of difficulty of the students' mathematical communication skills were not examined in this study. The validation of learning tools in this research is limited, so the validation of learning tools may change if tested on a wider scale. Since only small groups of students participated in the product testing, the responses they provided to the learning tools were also limited. So, it is possible that the quality of learning tools could change if they were tested on a wider scale. When testing students' mathematical communication abilities, there are fewer of them than when testing students' mathematical communication abilities.

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