Culture-Based Geometry Teaching Tool: An Effort To Instill Love of North Sumatra's Local Wisdom in Students

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Abstract. The primary objective of this study was to create educational resources rooted in the indigenous knowledge of North Sumatra. Employing the 4-D development model, the research utilized both qualitative and quantitative analyses. The outcome was the production of a geometry learning tool, subjected to assessments of validity, practicality, and efficacy. The tool's testing revealed notable improvements in students' mathematical problem-solving skills between Trial I and Trial II, with indicators displaying an average increase of 0.35%, 3.99%, 16.22%, and 8.32%, respectively.

Keywords: Geometry, Learning Tools, Local Wisdom.

1 Introduction

In today's advanced technological age, the augmentation of human resources (HR) holds significant importance, notably through education. Education stands as a pivotal element in the enhancement of human resources [1]. It encompasses a meticulously designed human activity aimed at fostering human qualities in students, often aligned with governmental regulations and contemporary curriculum advancements. Corresponding studies affirm that the curriculum embodies an all-encompassing blueprint pertaining to educational undertakings within schools [2].

Education is not solely about imparting knowledge; it's about cultivating an appreciation for diversity and heritage. Schools must adapt to the evolving landscape of the 21st century [3]. In today's globalized world, the preservation of local wisdom and cultural heritage within educational frameworks holds profound significance. Amid the fourth industrial revolution, there's an expectation for students to adeptly utilize technology in their daily routines, particularly in the educational sphere. Given this scenario, the incorporation of technology within education becomes imperative. Simultaneously, it's essential to integrate indigenous values into learning practices to preserve students' patriotism and local identities amidst rapid

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globalization. One effective approach involves amalgamating student learning resources with technological tools. An endeavor to instill local wisdom values includes the design, construction, and advancement of educational materials rooted in these cultural values [4].

Indonesia's rich cultural diversity significantly facilitates the creation of tools fused with local wisdom specific to each area [5]. These learning tools encompass all necessary elements compiled to aid educators in accomplishing learning objectives while assisting students in their studies [6]. This endeavor aligns with the vision, mission, and goals of the Primary School Teacher Education Study Program, aiming to generate research outputs, advance science and technology relevant to elementary education, and devise teaching models aligned with children's attributes rooted in indigenous knowledge [7].

With the advent of the updated curriculum, the existing learning resources are perceived as inadequate for meeting the students' requirements. To address this challenge, supplementary reading materials are essential, particularly within the Geometry curriculum [8]. Geometry stands as a compulsory subject for third-semester students enrolled in the Elementary School Teacher Education Study Program. It serves as a pivotal course intended to furnish aspiring educators with fundamental knowledge, enabling them to impart geometry lessons engagingly while upholding essential foundational principles [9]. This study of basic geometry aims to enhance students' capacity to interrelate geometric concepts (connection); employ problem-solving reasoning; and hone mathematical communication skills concerning geometric principles. Furthermore, it facilitates the identification of the scope and depth of geometric content within the fundamental mathematics curriculum [10].

The regular changes in the curriculum are a pertinent necessity in education to align learning with the evolving times, technological advancements, and societal demands [8][9]. When curricula change, it becomes essential to update and adapt the content of student textbooks to remain relevant and aligned with the new learning objectives.

Local wisdom plays a crucial role in this context. When modifying content, it is vital to incorporate aspects of local wisdom into the educational curriculum. This isn't merely about preserving and promoting local cultural heritage but also about enabling students to identify with their cultural roots [5]. Integrating content related to local wisdom helps enhance students' understanding and engagement with the taught material. It also contributes to creating an inclusive and diverse learning environment where students feel valued and connected to their cultural heritage.

By intertwining local wisdom into the content, student textbooks can become more holistic and comprehensive sources of knowledge [6][7]. Moreover, this approach supports educational goals to foster attitudes of appreciation, understanding, and preservation of cultural diversity within society.

According to the aforementioned description, the researcher infers that educators necessitate educational tools infused with local wisdom. Moreover, there's a need for teaching aids that integrate technology and offer students appropriate and pertinent learning resources. Consequently, the researchers devised the necessary teaching tools for managing learning in this study, encompassing: A. Semester Learning Plan (RPS): RPS serves as a structured blueprint outlining the learning process activities. B. Teaching Materials: These materials act as comprehensive guides, serving as standard references for specific subjects. They possess the following attributes: (1) Sourced teaching materials; (2) Applicability as standard references for specific subjects; (3) Systematic and simplified organization; (4) Accompanied by instructional guidance [11]. C. Assessment Instrument: Assessment entails a continuous and systematic series of activities designed to gather data concerning students' learning processes and outcomes.

This article delves into a groundbreaking initiative aimed at integrating North Sumatra's rich local wisdom into the teaching of geometry. The development of culture-based teaching tools in geometry not only fosters a deeper understanding of mathematical concepts but also nurtures an enduring bond between students and their regional heritage. This innovative approach strives to infuse educational settings with the essence of local traditions, instilling in students a profound appreciation for their cultural legacy while enhancing their academic prowess in mathematics.

2 Method

This study follows a Research and Development (R&D) framework utilizing Thiagarajan's 4D model, encompassing the sequential phases of define, design, develop, and disseminate [12].

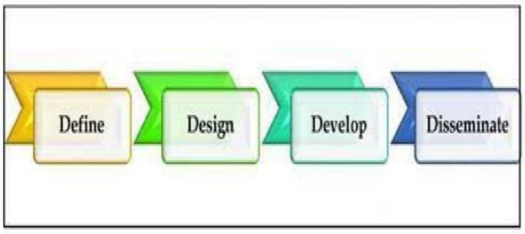

Fig. 1. Reserach Design.

The 4D development model by Thiagarajan was selected by the researchers due to its systematic flow, particularly for crafting teaching materials, aligning with the notion that its stages are specifically tailored for learning tool development, including the development of teaching aids [13].

The initial phase is the Define stage, encompassing five primary steps: (1) Front-End Analysis: The existing teaching materials, primarily textbooks, were found unchanged and untouched. (2) Student Analysis (Learner Analysis): A study aimed at understanding student characteristics. (3) Concept Analysis: Identifying the key concepts intended for instruction. (4) Task Analysis: Identifying the primary skills for investigation and analyzing them into potential additional skills. (5) Formulating Learning Objectives (Specifying Instructional Objectives): Summarizing the outcomes of concept and task analysis to define the behavioral aspects for research objectives.

The subsequent stage is Design, focusing on the development of learning tools, involving four essential steps: (1) Criterion Test Construction: Preparing standard tests. (2) Media Selection: Choosing appropriate media in line with material characteristics and learning objectives. (3) Format Selection: Reviewing existing Emodule formats and determining the format for the learning tools to be developed. (4) Initial Design: Drafting an initial plan according to the selected format.

Moving to the Develop stage, the crafted teaching materials underwent scrutiny and evaluation by a panel of experts, including content experts for book assessment, graphic experts for layout evaluation, language experts for linguistic review, and technology experts for multimedia creation and web application development.

Finally, the Evaluate stage assesses the effectiveness of the teaching tools to gauge their efficiency in real-world application. The Disseminate phase focuses on product implementation, testing, and product revision evaluations [14]. Subsequent to the expert assessments, adjustments were made based on the received feedback, resulting in the production of the initial draft.

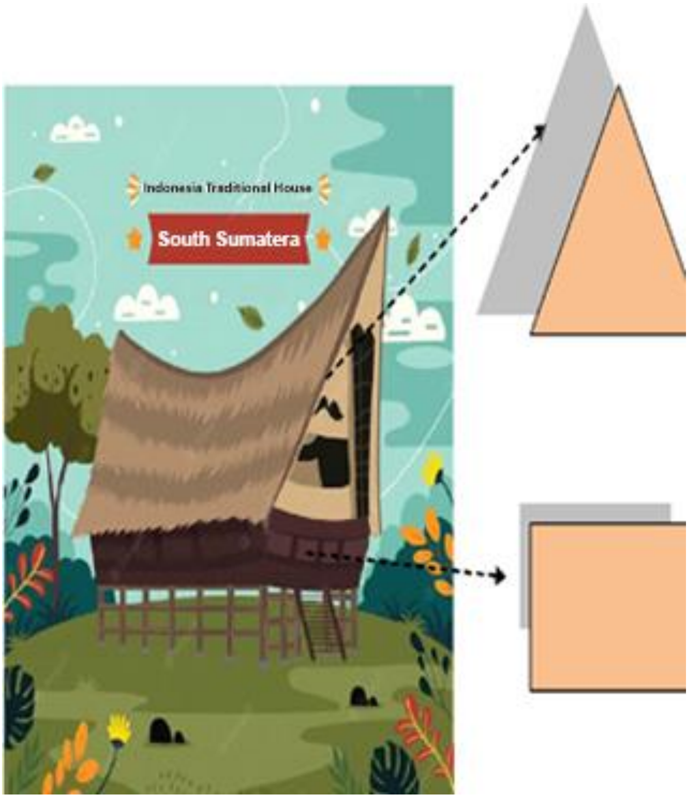

Fig. 2. Local Wisdom Design.

3 Results and Discussion

3.1 Validity

The first draft, known as Draft-1, is generated after the initial phases of defining and designing. Following this, a validity test is conducted, involving experts in the field (expert review) and field trials. The expert validation covers all the developed educational materials, which include: (1) Semester Learning Plan (RPS); (2) Activity sheet (LK); and (3) Problem Solving Ability Test (TKPM). The expert validation primarily assesses format, content, illustrations, and language, encompassing all the educational tools that have been developed. The feedback from the expert validation, which may include corrections, critiques, and suggestions, serves as the foundation for making revisions and enhancements to the educational materials. The revised learning tool, informed by the input from the validators, is referred to as Draft-2.

The selection of validators encompassing two subject matter experts and one cultural specialist serves a crucial purpose in ensuring a comprehensive and holistic evaluation of the Semester Learning Plan (RPS). These experts, with their diverse backgrounds and expertise, bring forth a multifaceted assessment approach. The subject matter experts meticulously scrutinize the format, language, and content of the RPS from an academic perspective, ensuring accuracy, clarity, and alignment with educational standards. Simultaneously, the cultural specialist offers invaluable insights, evaluating the RPS's cultural resonance, ensuring that it authentically integrates North Sumatra's local wisdom into the teaching tool. This collective validation approach aims to guarantee not only pedagogical excellence but also the respectful incorporation of cultural heritage into the educational fabric.

In carrying out revisions, the researcher refers to the results of the discussion by following the validator's suggestions and instructions. This effort aligns with the views expressed by Biggs [15] who emphasizes the importance of developing and improving learning planning to achieve better learning quality, which is consistent with the approach adopted in this research.

The results of validation by experts on the RPS (Lesson Plan) and research worksheet (LK) indicate that all aspects studied have received positive validation. Validity in this context refers to the level of authenticity and accuracy of the research results and the learning planning outlined in the RPS and LK. In other words, the research findings are considered to meet established standards and can be relied upon to support the educational or research objectives. This validity demonstrates that the RPS and LK developed have undergone evaluation by competent experts and have been shown to reflect the necessary quality and accuracy within the context of learning or research. As a result, this research can be trusted as a strong foundation for making further decisions and actions in the field of education or the relevant research area.

3.2 Feasibility

Feasibility refers to the practicality or viability of a project or plan being successfully executed within a given set of circumstances. It assesses the potential for an idea, project, or initiative to be achievable, realistic, and effective considering various factors such as resources, time, budget, technology, and available expertise [12]. A feasibility study is often conducted to evaluate and analyze these aspects to determine whether a proposed project or plan is feasible before committing further resources or efforts into its implementation.

Once the product or research is deemed valid, the subsequent step involves testing for practicality, gauging its effectiveness in real-world scenarios. Practicality assesses whether the product or research methods can be readily applied by end-users, such as teachers, students, or participants. The practical implementation of Geometry-based learning tools rooted in local wisdom is evaluated through an observation sheet assessing the execution of these tools in Geometry lessons. Analysis of the observed data on the implementation of these tools concluded that in Trial I, the attainment of the learning tool implementation level fell within the high category. This signifies that the Geometry learning tools based on local wisdom were considered practical and applicable. Table 1 illustrates the average observation scores assessing the feasibility of the learning tools for each session in Trial I:

Table 1. Average Observation Value For The Feasibility.

Feasibility Score	**Meeting**				**Total Average**	**Grade**
	1	2	3	4		
Trial-1	3,75	3,88	3,63	3,81	3,77	High

Therefore, it can be concluded that the Geometry learning tools developed based on local wisdom are practical and feasible for implementation in educational settings. This practicality suggests their potential effectiveness in actual classrooms, thereby enriching the teaching and learning experiences for educators and students alike. Nevertheless, to comprehensively assess the impact and sustainability of these tools within the educational landscape, further research and evaluations, including long-term assessments, are imperative. Conducting extensive and longitudinal studies will provide deeper insights into the tools' enduring effects on students' learning outcomes and their integration into the broader educational framework, ensuring their continued relevance and efficacy over time.
For more details, see Figure 3 below.

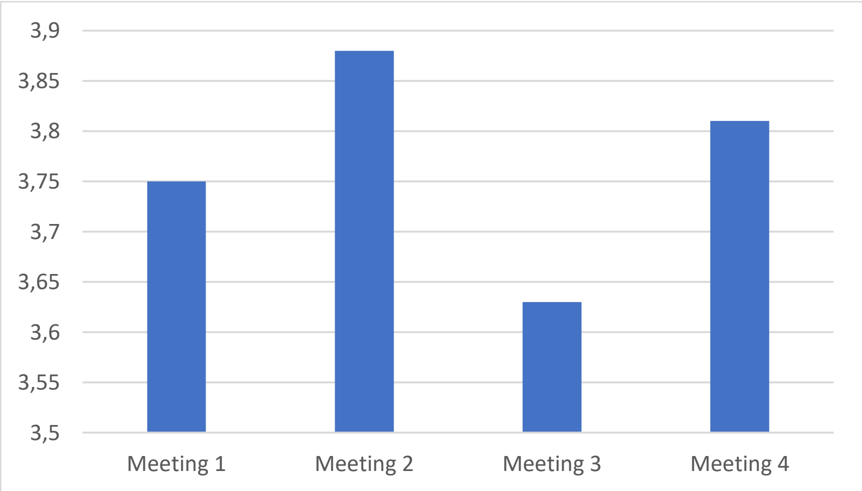

Fig. 3. Implementation of Trial I Learning Tools for Each Meeting.

When the implementation of the learning materials reaches a score above 3.5 for each meeting, and even achieves the highest score in the second meeting with a score of 3.9, it indicates that the learning materials have been successfully implemented. These scores reflect the level of effectiveness in implementing the learning materials. The higher the score, the better the implementation of the learning materials. In this context, scores above 3.5 indicate that the learning materials have achieved a good level of implementation and align with the set objectives. The score of 3.9 in the second meeting reflects the highest level of implementation, indicating that the learning materials may have functioned very well in that particular meeting. This can be interpreted as the learning materials being effective in supporting the achievement of learning objectives, especially in the second meeting. However, it's important to note that for a more comprehensive assessment, other factors like long-term impact, student understanding, and other relevant measurements should also be considered in evaluating the success of the learning materials. Mathematical problem solving abilities in trial I are presented in Figure 4 below.

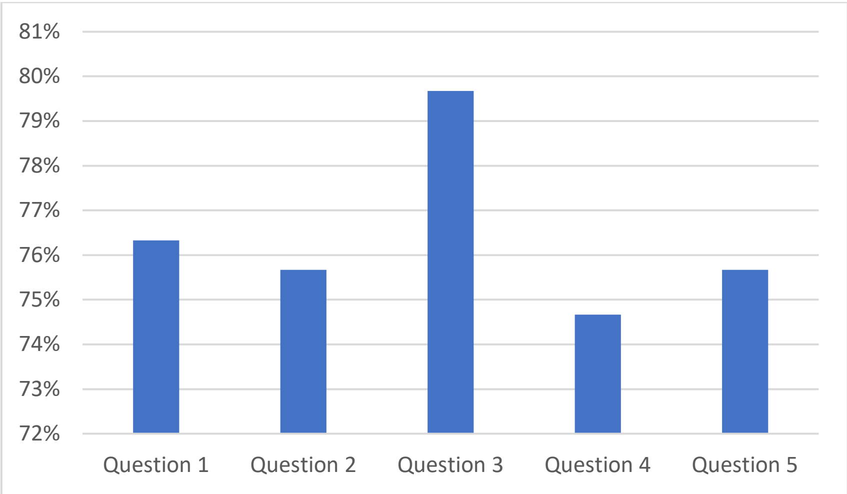

Fig. 4. Attainment of Educational Goals in Enhancing Mathematical Problem-Solving Skills during Trial I.

The evaluation of mathematical problem-solving abilities in Trial I is used to assess the level of achieving the learning objectives. In this context, there are five questions used to measure this ability. Question 4 has the lowest success rate at 74.7%, while Question 3 has the highest success rate at 79.6%. This means that Question 4 with a 74.7% success rate indicates a lower level of success in solving mathematical problems compared to Question 3, which has a 79.6% success rate. This suggests that students may face specific difficulties in Question 4, and this may be an area that requires further attention in the development or refinement of teaching methods. Meanwhile, the higher success rate in Question 3 indicates that the teaching method or instruction used to teach the concept tested in Question 3 may be effective. This can serve as a positive reference for designing future teaching, considering the successful approach used in Question 3 to improve students' learning outcomes in mathematical problems.

The results of the data analysis, which observed the implementation of Geometry learning tools based on local wisdom, concluded that the level of implementation achievement in Trial II is categorized as high. This suggests that the Geometry learning tools based on local wisdom are considered practical and applicable. These findings imply that the implementation of these tools has been successful and effective, enhancing the teaching and learning experience within the scope of the study. Further research and ongoing assessments may be necessary to evaluate the sustained practicality and impact of these tools in various educational settings. The average observation values for the suitability of the learning tools for each meeting in Trial II are presented in Table 5 below.

Table 2. Average Observation Value For The Feasibility.

Feasibility Score	Meeting				Total Average	Grade
	1	2	3	4		
Trial-2	3,94	4,00	3,88	3,94	3,94	High

Based on the information provided in the table, 8 tis evident that the overall average of the two observers during Trial I was as follows: 3.94 for the first meeting, 4.00 for the second meeting, 3.88 for the third meeting, and 3.94 for the fourth meeting. Moreover, the total average score across all five meetings was 3.94, categorizing it as ‚high.‘ Consequently, it can be concluded that the Geometry learning tools, which are based on local wisdom and were developed for this study, exhibit practicality in terms of their implementation. These findings strongly indicate that the implementation of these tools consistently yielded positive results, enhancing the learning experience within the context of the research. To further assess their practicality and impact in various educational settings, additional research and evaluations may be necessary. For a more detailed analysis, please refer to Figure 5 below.

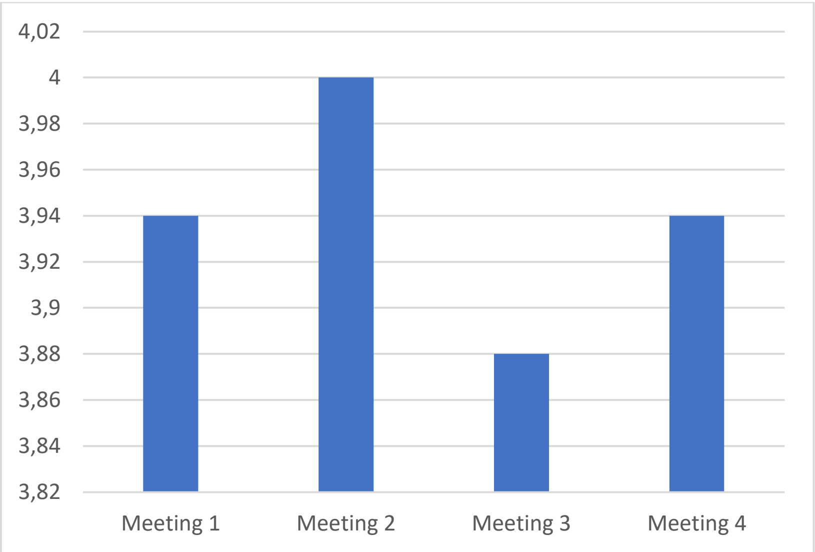

Fig. 5. Implementation of Trial II Learning Tools for Each Meeting.

3.3 Effectivity

To assess the effectiveness of a learning tool, one approach is to evaluate the level of mastery achieved after the tool's utilization.

To assess the effectiveness of a learning tool, one approach is to evaluate the level of mastery achieved after the tool's utilization. Mastery, in this context, refers to the depth of understanding or proficiency attained by students in a particular subject matter or skill set. The evaluation process involves measuring the extent to which students have comprehended and can apply the concepts or skills taught using the tool.

This assessment typically involves various forms of testing, such as quizzes, exams, or performance assessments, tailored to measure the specific learning objectives targeted by the tool. These evaluations aim to gauge the students' grasp of the subject matter, their problem-solving abilities, and their capacity to utilize the acquired knowledge or skills effectively.

However, assessing mastery solely based on test scores or performance outcomes may present limitations. It might not fully capture the breadth of learning outcomes or the depth of understanding attained by students. Some students might excel in assessments but struggle to apply their knowledge in real-world scenarios. Therefore, a more comprehensive evaluation might incorporate diverse assessment methods, including observations, projects, and practical applications, allowing a multifaceted analysis of students' mastery levels.

Furthermore, evaluating the effectiveness of a learning tool shouldn't be a one-time endeavor. Continuous monitoring and feedback mechanisms are crucial to track students' progress over time, identify areas needing improvement, and adapt the tool to address evolving educational needs. Long-term evaluations enable educators to discern the sustained impact of the tool on students' learning outcomes and instructional practices.

In this research, students' mastery levels are gauged through their mathematical problem-solving abilities using mathematical problem-solving tests and their self-efficacy through a self-efficacy questionnaire that was developed for the study. These tests and questionnaires are administered following four learning sessions, with the goal of determining the extent of students' mastery and their grasp of the subject matter studied. The criteria for students to be considered as having mastered the material (individual mastery) in mathematical problem-solving are met if at least 75% of the students answer correctly. A class is regarded as having achieved overall mastery (classical mastery) if at least 85% of its students have successfully completed their studies.

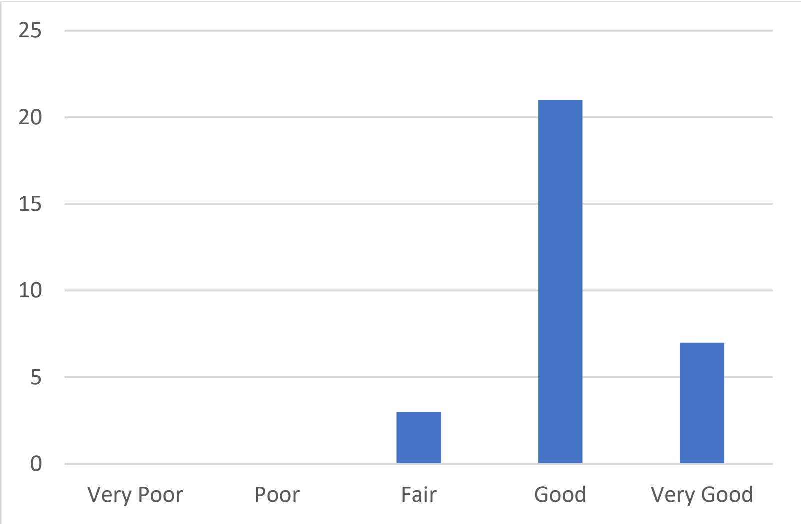

Fig. 6. Attainment of Educational Goals in Enhancing Mathematical Problem-Solving Skills during Trial II.

Moreover, the outcomes of students' classical completion in solving mathematical problems during field trial II are depicted in Table 3.

Table 3. Classical Completion of Students' Mathematical Problem Solving Abilities In Field Trial II

Category	Mathematical Problem Solving Abilities	
	Number of Student	Percentage
Complete	28	90,32
Incomplete	3	9,68
Total	31	100

Figure 7 below displays an overview of the percentage of classical completeness criteria pertaining to students' mathematical problem-solving abilities during trial II**.**

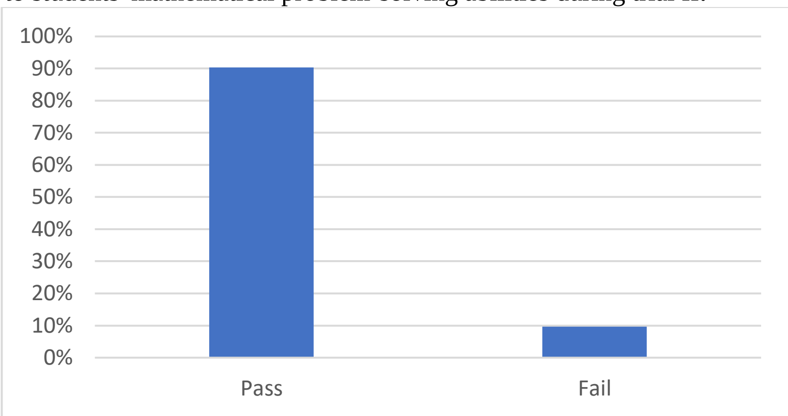

Fig. 7. Percentage Of Classical Completion Of Mathematical Problem Solving Ability In Test II.

The data presented in Table 3 and Figure 7 indicates a notable advancement in students' mathematical problem-solving skills across various indicators, marking an improvement from Trial I to Trial II following the implementation of Geometry learning tools grounded in local wisdom. Consequently, it can be inferred that these tools have positively influenced the enhancement of mathematical problem-solving abilities. This positive impact is observable not only in the overall test outcomes but also in the specific indicators assessing students' problem-solving skills.

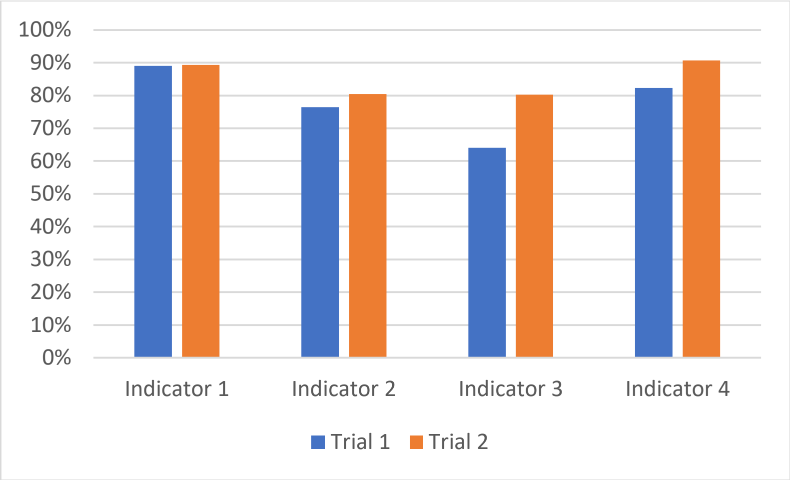

Fig. 8. Increased Mathematical Problem Solving Capability In Every Indicator

Based on the analysis of the posttest outcomes from Trial I and Trial II, it's apparent that students' proficiency in mathematical problem-solving aligns with the set classical completeness criteria, marked at a minimum of 85%. This achievement owes credit to the tailored learning materials and problem sets embedded within the worksheets, drawing from Geometry learning tools infused with local wisdom. Implementing these tools encourages active student engagement in problem-solving. Guided by instructors or peers, students construct their own knowledge and derive conclusions from the acquired information.

Integrating geometry materials with elements of local wisdom in learning renders geometry more comprehensible by linking it to daily life. It enhances motivation, makes abstract concepts more tangible, provides practical experiences, and respects students' culture. This robust connection between geometry and cultural context aids students in grasping geometry concepts more effortlessly, enriching the learning journey.

These findings corroborate research by Priyatna and Niken [8], Prahmana et al. [10], and Uskono et al. [11], underscoring that cultural integration, particularly concerning traditional foods and mathematical concepts, aids students in understanding mathematical principles more effectively. This fusion enhances the relevance of these concepts in students' daily lives, ultimately augmenting their grasp of mathematical ideas.

4 Conclusion

Development of Geometry learning tools based on local wisdom using the Thiagarajan development model, aims to improve mathematical problem solving abilities. From the results of the research that has been carried out, the conclusions that can be outlined that geometry learning tools based on local wisdom improved students' mathematical problem solving abilities from trial I to trial II with an average increase per indicator of 0.35%; 3.99%; 16.22% and 8.32%. The learning tools developed have met the effective criteria, namely (1) students' classical learning mastery in trial I has reached the good category and in trial II has reached the very good category; (2) achievement of student learning objectives during learning activities meets the ideal criteria set; (3) positive student response to the components of the learning tools and learning activities developed; and (4) allocation of ideal time use.

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