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Development of Mathematics Teaching Materials Based on the ALQURUN Teaching Model to Improve Students' Mathematical Problem-Solving Skills

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a b s t r a c t

Background: Mathematical problem-solving ability is recognized as a fundamental competency in 21st-century education; however, its development remains limited due to the predominance of conventional instructional practices and the insufficient availability of structured teaching materials. Therefore, there is a need to develop innovative teaching materials that can serve as an alternative to support more meaningful, systematic, and problem-oriented learning processes.
Aims: This study aimed to examine the validity, effectiveness, and students' responses toward the developed instructional materials in enhancing mathematical problem-solving skills.
Methods: The study employed a Research and Development (R&D) approach using the ADDIE model, consisting of analysis, design, development, implementation, and evaluation stages. The participants were seventh-grade students at Integrated Junior High School Al-Mas'udiyah, Bandung Regency, West Java. Data were collected through expert validation sheets, mathematical problem-solving tests, and student response questionnaires. The obtained data were analyzed using descriptive quantitative techniques.
Results: The findings revealed that the developed teaching materials achieved a validity score of 83, indicating that they were highly feasible for instructional use. In addition, the instructional materials demonstrated effectiveness, as reflected by 80% student learning mastery in mathematical problem-solving tests. Student responses also indicated a very positive perception, with an average response score of 88.
Conclusion: These findings suggest that the ALQURUN-based instructional materials successfully facilitated active learning engagement and supported students' mathematical problem-solving development.

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1. Introduction

Mathematical problem-solving skills have been positioned as a fundamental competency in 21st-century learning, serving as a bridge between the mastery of mathematical concepts and their application in various real-life contexts. The urgency of this skill is not only viewed from

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a cognitive perspective but also from its contribution to developing students' critical thinking, creativity, communication, and collaboration skills in addressing complex problems in the modern era. In recent literature, problem-solving-oriented learning has been identified as capable of developing mathematical inference, reasoning, and communication skills that go beyond mere procedural fluency (Clements et al., 2023; Schoenfeld, 2020). Furthermore, the shift in the curriculum paradigm has also emphasized mathematical modeling, open discussion, and the use of various problem-solving strategies, so that students' thinking processes are not only focused on the final result but also on the process of justification and reflection (OECD, 2023).

Conceptually, mathematical problem-solving has become the core of the global mathematics education reform movement, where the focus of learning has shifted from procedural approaches toward the development of higher-order thinking processes. In various studies, problem-solving is understood as a complex cognitive process involving the ability to analyze problems, design various solution strategies, and justify solutions through logical and systematic mathematical arguments (Chong et al., 2019; Gutstein, 2003; Wright et al., 2021). In line with these developments, the integration of problem-based approaches, mathematical modeling, and learning that is responsive to cultural and linguistic diversity has been increasingly emphasized. These approaches have been reported to enhance students' conceptual understanding, affective engagement, and metacognitive skills, while also expanding mathematical literacy in the digital age (An, 2020; Freeman-Green et al., 2021; Mughal et al., 2021; Starčič et al., 2023; Tanase, 2020).

Nevertheless, various research findings indicate that students' mathematical problem-solving skills have not yet developed optimally. Difficulties in understanding problems, designing solution strategies, and reflecting on the solutions obtained are still frequently reported in various studies (Hadi & Retnawati, 2022; Rahmawati & Juandi, 2022). Mathematics instruction in schools still tends to be dominated by a procedural approach focused on final outcomes, so the development of higher-order thinking skills has not been fully facilitated (Suryadi et al., 2021). Furthermore, the instructional materials used in learning are generally not designed to support a systematic problem-solving process but rather emphasize routine, mechanistic practice problems (Putri et al., 2023). This situation indicates that the need for innovative instructional materials capable of comprehensively facilitating the problem-solving thinking process is becoming increasingly urgent.

Furthermore, based on a review of the literature, a research gap still exists regarding the suboptimal integration of innovative learning models with the development of structured instructional materials. Most previous studies have focused primarily on the implementation of learning models without systematically integrating the development of instructional materials. On the other hand, research on instructional material development tends to focus on content and media aspects, without integrating the syntax of learning models that explicitly support mathematical problem-solving skills (Lestari et al., 2023). Additionally, supporting factors such as curriculum design, teacher professional support , and a school culture that encourages the exploration of various solutions have been identified as key determinants in the successful implementation of problem-solving-based learning (Ramsay-Jordan, 2022).

To address these issues, the development of mathematics instructional materials based on the Acknowledge, Literature, Quest, Unite, Refine, Use, Name (ALQURUN teaching model)

is proposed in this study. This model is designed to facilitate a systematic and constructivist learning process, beginning with the activation of prior knowledge, concept exploration, the presentation of contextual problems, collaboration, reflection, and culminating in concept generalization. This approach aligns with constructivist theory, which emphasizes that knowledge is actively constructed through meaningful learning experiences (Schunk, 2020). Thus, the integration of the ALQURUN model into instructional materials is expected to enhance students' mathematical problem-solving skills more effectively.

The novelty of this study lies in the integration of the ALQURUN learning model into the development of mathematics instructional materials designed systematically and oriented toward improving students' mathematical problem-solving skills. This study focuses not only on the development of instructional materials but also on testing their effectiveness, thereby generating theoretical and practical contributions to innovations in mathematics education. Based on the above description, the objectives of this study are to develop valid and practical mathematics teaching materials based on the ALQURUN teaching model, to analyze their effectiveness in improving students' mathematical problem-solving skills, and to describe the improvement in students' mathematical problem-solving skills following the use of the developed teaching materials.

1.1 Mathematical problem-solving skills

Mathematical problem-solving ability is one of the essential competencies in mathematics learning that reflects students' capacity to understand, formulate, and solve problems systematically, as well as interpret the solutions obtained. From the perspective of the National Council of Teachers of Mathematics, problem-solving is viewed as a primary process standard that must be developed alongside mathematical reasoning, communication, connection, and representation skills. Conceptually, this ability involves not only the application of procedures but also higher-order thinking processes such as analysis, synthesis, evaluation, and reflection on the strategies used (Schoenfeld, 2020; Clements et al., 2023). In the context of 21st-century education, mathematical problem-solving skills are also linked to mathematical literacy, which emphasizes the ability to use mathematics flexibly and meaningfully in various real-life situations (OECD, 2023; Wright et al., 2021).

Indicators of mathematical problem-solving ability generally refer to the stages proposed by Polya, namely understanding the problem, devising a plan, carrying out the plan, and looking back at the solution. These stages have been widely used as a basis for measuring students' mathematical problem-solving abilities in various studies (Rahmawati & Juandi, 2022). Furthermore, these indicators are often further developed by incorporating aspects of mathematical communication, representation, and metacognitive skills, such as the ability to monitor and evaluate one's thinking process during problem-solving (Hadi & Retnawati, 2022). Thus, mathematical problem-solving ability is not merely assessed by the final outcome but also by the thinking process students undergo while solving problems.

Various previous studies have shown that students' mathematical problem-solving skills remain relatively low and have not yet developed optimally. Difficulties frequently experienced by students include an inability to understand problems in depth, difficulty in devising appropriate solution strategies, and a lack of ability to reflect on and evaluate the solutions obtained (Hadi & Retnawati, 2022; Rahmawati & Juandi, 2022). This situation is also

influenced by teaching practices that remain dominated by procedural approaches and a focus on final outcomes, resulting in higher-order thinking processes not being optimally facilitated (Schoenfeld, 2020). Additionally, the limited use of contextual problems and the scarcity of opportunities for students to discuss and explore various problem-solving strategies also act as barriers to the development of mathematical problem-solving skills (Wright et al., 2021).

A number of empirical studies indicate that improvements in mathematical problem-solving skills can be achieved through the implementation of problem-oriented learning, the use of real-world contexts, and providing students with opportunities for mathematical reflection and discussion. This approach has been proven to enhance reasoning skills, conceptual understanding, and student engagement in mathematics learning (Clements et al., 2023; OECD, 2023). Therefore, the development of mathematical problem-solving skills must be supported by a systematic, contextual, and student-centered instructional design, enabling students to optimally develop critical and creative thinking skills.

1.2 The ALQURUN teaching model

The ALQURUN (Acknowledge, Literature, Quest, Unite, Refine, Use, Name) learning model has been introduced as an instructional design framework that emphasizes the integration of literacy, problem-solving, and knowledge construction in a gradual and systematic manner. Conceptually, ALQURUN is positioned as a learning model that combines constructivist approaches, problem-based learning, and scientific literacy into a single structured learning sequence. In its implementation, the learning process is not only directed toward achieving final outcomes in the form of answers but also toward the process of exploration, argumentation, and documentation of mathematical ideas carried out gradually by students. This is supported by findings that ALQURUN is capable of enhancing mathematical abilities, particularly problem-solving and mathematical communication, through students' active engagement in every phase of learning (Putra et al., 2020; Suherman et al., 2019; Sutiarso, 2021; Sari & Ningtias, 2023).

More specifically, the ALQURUN syntax consists of seven main stages designed to facilitate higher-order thinking processes. The Acknowledge stage is aimed at identifying and understanding the problem context and relating it to students' prior knowledge. In this stage, prior understanding and previous learning experiences are activated as a foundation for building new concepts. Next, the Literature stage is used to explore various sources of knowledge, including written references, discussions, and mathematical representations, ensuring that the ideas developed have a strong conceptual foundation. This stage highlights a unique characteristic of ALQURUN, as it positions literature as an integral part of the learning process, rather than merely an adjunct (Putra et al., 2020).

The next stage is Quest, where the main problem is formulated and explored in depth. In this phase, students are encouraged to ask questions, develop strategies, and design various alternative solutions. This process is then followed by the Unite stage, which involves integrating the various ideas and strategies generated, either through group discussions or shared reflection. At this stage, collaboration and mathematical communication are emphasized as means to synthesize diverse perspectives into a more comprehensive solution (Suherman et al., 2019).

Next, the Refine stage is conducted to refine the generated solutions through evaluation, verification, and improvement. In this phase, the accuracy of concepts, logical reasoning, and

procedural correctness are critically analyzed. This stage is then followed by Use, where the obtained solutions are applied to broader contexts or new situations, thereby fostering the development of knowledge transfer skills. The final stage is Name, which involves labeling, generalizing, and justifying the discovered concepts or strategies. In this phase, students' thinking is systematically documented and communicated, thereby strengthening conceptual understanding and mathematical representation skills (Putra et al., 2020; Sutiarso, 2021).

Empirically, the effectiveness of ALQURUN has been supported by various studies showing a significant improvement in students' mathematical problem-solving skills. The results of a meta-analysis indicate that the implementation of ALQURUN has a moderate to high positive effect on mathematical ability, particularly in the areas of conceptual understanding and reasoning (Sutiarso, 2021). Furthermore, experimental studies also indicate that students learning through the ALQURUN model demonstrate superior problem-solving skills compared to conventional instruction, as they are actively engaged in the processes of exploration and reflection (Sari & Ningtias, 2023). Thus, ALQURUN can be viewed as an innovative learning model that emphasizes not only learning outcomes but also the thinking process, literacy, and the continuous construction of knowledge.

2. Methods

2.1 Research design

This study was designed using the Research and Development (R&D) method, which aims to develop a product in the form of mathematics teaching materials based on the ALQURUN teaching model and to test the effectiveness of its use in learning. The R&D method was chosen because it allows for the production of valid, practical, and effective educational products through a series of systematic development stages. The development model used is the ADDIE model (Analysis, Design, Development, Implementation, Evaluation), which consists of five main stages: analysis, design, development, implementation, and evaluation (Sugiyono, 2015). This model was chosen because it is systematic, flexible, and widely used in the development of teaching materials and learning media.

2.2 Research procedure

The research procedures were carried out by referring to the ADDIE development model, which includes five stages as shown in Figure 1.

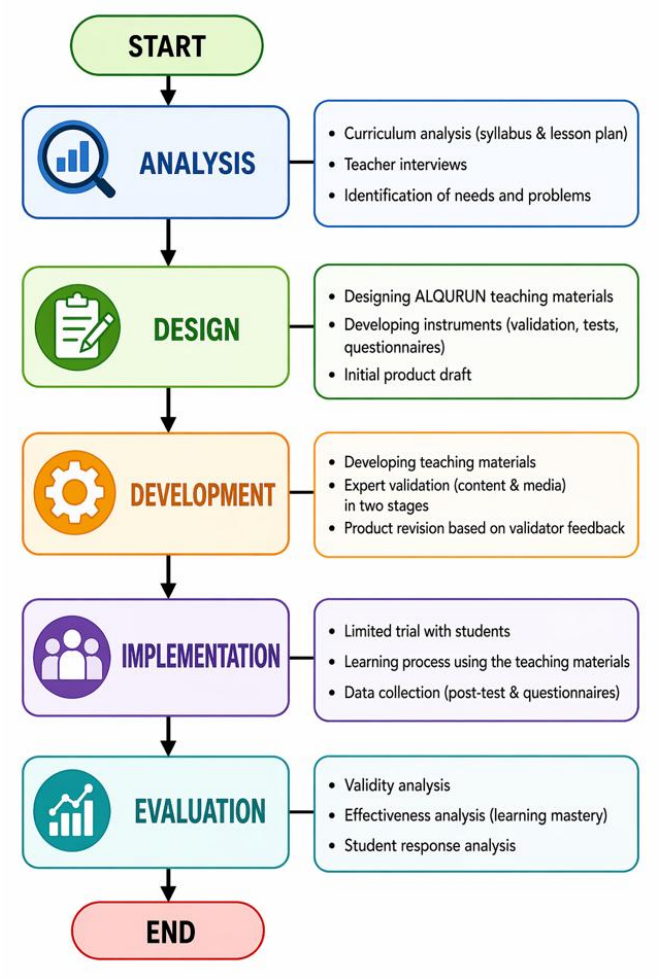


Figure 1. Research Procedures

Based on the figure 1, the research procedures consists of five stages, namely analysis, design, development, implementation, and evaluation. In the analysis stage, a needs analysis was conducted to identify instructional problems and determine the characteristics of the learning process. This stage involved curriculum analysis, including the examination of syllabus documents and lesson plans, as well as interviews with teachers to explore classroom needs, learning obstacles, and students' characteristics. The results of this stage served as the foundation for designing the instructional product.

In the design stage, the initial framework of the instructional product was prepared based on the findings from the analysis stage. The researchers designed the learning materials and developed research instruments, including validation sheets, learning achievement tests, and student response questionnaires. An initial prototype of the product was then created to guide the development process.

The development stage focused on producing the instructional product and validating its feasibility. The prototype was developed into a complete instructional product and subsequently evaluated by experts in content and media design. The validators assessed the appropriateness, accuracy, and usability of the product. Revisions were carried out based on the experts' suggestions and feedback to improve the quality of the product before implementation.

In the implementation stage, the revised product was tested in a limited classroom setting involving students. The instructional product was integrated into the learning activities, and

students participated in the learning process using the developed materials or media. During this stage, data were collected through post-tests and questionnaires to measure students' learning outcomes and responses toward the product.

Finally, the evaluation stage was conducted to determine the validity, effectiveness, and practicality of the developed product. The validity of the product was analyzed based on expert validation results, while effectiveness was measured through students' learning mastery and achievement scores. In addition, students' responses were analyzed to evaluate the practicality and acceptance of the instructional product in the learning process. The findings from this stage were used to draw conclusions regarding the feasibility and effectiveness of the developed instructional product.

2.3 Participants

The participants in this study were composed of students, mathematics teachers, and expert lecturers who were involved as required at each stage of the development process. The primary research subjects were 20 eighth grade students at Al Mas'udiyah Integrated Junior High School, Bandung Regency, West Java who were selected using purposive sampling. This selection was based on the consideration that prerequisite algebra material had been studied and heterogeneous ability levels had been demonstrated. The students were involved in the implementation stage to evaluate the practicality and effectiveness of the ALQURUN teaching model based instructional materials, particularly in measuring mathematical problem solving skills.

In addition, one mathematics teacher was involved as a supporting informant. Information regarding classroom learning conditions and instructional material needs was provided, and facilitation during the classroom pilot test was carried out. During the development phase, product validation was conducted by two types of validators, namely a content expert, represented by a mathematics education lecturer, and a media expert, represented by a lecturer or practitioner with expertise in instructional design or educational media. Evaluations and feedback were provided on the appropriateness of content, language clarity, presentation, and visual design of the instructional materials.

By involving these participants, comprehensive data were expected to be obtained, and the overall quality of the instructional materials was able to be described in terms of validity, practicality, and effectiveness in improving students' mathematical problem solving skills.

2.4 Data collection

Data collection techniques in this study were conducted through interviews, questionnaires, tests, and documentation. Interviews were used during the *analysis* phase to obtain information regarding learning conditions, instructional material needs, and challenges faced by teachers and students. Questionnaires were used to collect data on students' responses to the instructional materials based on the ALQURUN teaching model that were developed. Tests were used to measure students' mathematical problem-solving skills through *a posttest* after the learning process took place. Additionally, documentation was used to supplement research data, including learning materials, student work samples, and activities during the learning process. All these data collection techniques were conducted systematically to obtain accurate data supporting descriptive quantitative analysis.

The indicators of mathematical problem-solving ability in this study were formulated based on the stages of problem-solving according to George Polya.

Table 1. Mathematical Problem-Solving Ability Indicators

No.	Problem-Solving Indicators	Description
1	Understanding *the problem*	Students are able to identify known information, what is being asked, and rewrite the problem in a simpler form
2	*Devising a plan*	Students are able to determine the appropriate strategy or method for solving problems
3	*Carrying* out *the plan*	Students are able to solve problems in accordance with the planned strategy in a systematic and correct manner
4	Reviewing (*looking back*)	Students are able to re-evaluate the results of their solutions, check the accuracy of their answers, and draw conclusions

2.5 Data analysis

Data analysis in this study was conducted using quantitative descriptive methods to assess the validity, effectiveness, and student response to teaching materials based on the ALQURUN teaching model. The validation results from the validators were analyzed based on the modified approach proposed by Akbar (2015) using the following formula:

$$Validity\ Score\ (v) = \frac{Total\ score\ from\ validators}{Maximum\ total\ score} \times 100$$

The level of validity of the teaching materials was determined based on the criteria in Table 2.

Table 2. Validity Criteria

Validity Score	Criteria
86–100	Highly valid, ready for use as a learning resource
71–85	Valid, can be used as a learning resource
51–70	Fairly valid, can be used with minor revisions
31–50	Not very valid; not recommended for use as major revisions are needed
1–30	Invalid, cannot be used

Based on these criteria, instructional materials are deemed valid if they achieve a score of at least 71.

The effectiveness of the instructional materials is analyzed based on the results of the mathematical problem-solving ability test via the *posttest*. The scores obtained by students are converted into grades using the formula:

$$Value = \frac{Achieved\ score}{Max\ score} \times 100$$

Next, student learning mastery is determined based on the minimum competency criteria of 70. Students are considered to have mastered the material if they obtain a grade > 70. The effectiveness percentage is calculated using the formula:

$$\text{Effectiveness percentage } = \frac{Number\ of\ students\ who\ have\ completed}{Total\ number\ of\ students} \times 100\%$$

The criteria for the effectiveness of the teaching materials refer to Wahyuni (2019) as presented in Table 3.

Table 3. The Effectiveness Criteria

Percentage	Criteria
81–100	Very effective
61–80	Effective
41–60	Fairly effective
21–40	Less effective
< 20	Ineffective

Teaching materials are considered effective if the percentage of student mastery is > 60%. Analysis of the student response questionnaire was conducted using a Likert scale based on Riduwan (2012), using the formula:

$$\text{Response score } (p) = \frac{Total\ score}{Maximum\ total\ score} \times 100$$

The response scores are interpreted based on the criteria in Table 4.

Table 4. Student Response Score Criteria

Response Score	Criteria
$80 < p \leq 100$	Very good
$60 < p \leq 80$	Good
$40 < p \leq 60$	Fair
$20 < p \leq 40$	Poor
$p \leq 20$	Very poor

Based on these criteria, teaching materials are considered to have received a positive response if the average student response score is > 60.

3. Results

The product of this research and development project is a mathematics teaching material based on *the Acknowledge, Literature, Quest, Unite, Refine, Use, Name (ALQURUN) Teaching Model*. The data obtained in this study include curriculum documents, interview sheets, expert validation sheets, tests of students' mathematical problem-solving abilities, and student response questionnaires regarding the mathematics teaching materials based on the *ALQURUN teaching model*. The discussion of the research results is outlined as follows.

3.1 The process of developing mathematics teaching materials based on the ALQURUN teaching model

3.1.1 Analysis phase

This stage involves gathering information. The data analyzed in this study are as follows: 1) The lesson plans (RPP) used were junior high school (SMP) or MTs mathematics lesson plans for 7th grade, first semester, covering algebra; 2) The syllabus used was the junior high school (SMP) or MTs mathematics syllabus for 7th grade, first semester, covering algebra.

At this stage, interviews were also conducted with mathematics teachers at Al-Mas'udiyah Integrated Junior High School. The information obtained indicated that the curriculum in use is still the 2013 curriculum, and the methods employed by teachers consist of lectures and assignments. The primary teaching materials used in mathematics instruction are textbooks; students at Al-Mas'udiyah Integrated Junior High School live in dormitories, so their access to online materials is limited. Mathematics teaching materials need to be developed as an alternative to support the learning process.

3.1.2 Design phase

During this design phase, the format was selected, the structure of the instructional materials was determined, and the assessment instruments were developed. The selection of the format included the font to be used (Times New Roman), the paper size (A4 HVS paper), and the cover of the instructional materials, for which the initial draft was created using Canva. The structure of the teaching materials consists of the cover, a preface, a table of contents, core competencies, basic competencies, competency achievement indicators, a concept map, content, and a bibliography. The development of assessment instruments includes a media expert validation sheet, a content expert validation sheet, math problem-solving test questions, and a student response questionnaire. The development of these instruments began with creating a test blueprint, followed by the development of the assessment items.

3.1.3 Development phase

In this stage, the product was submitted to experts for review and evaluation to obtain comments and suggestions regarding the validity of the product in terms of media and content. The researcher used only one validator for each aspect, as these validators already had extensive experience in understanding student characteristics and abilities. Suggestions and feedback from the validators are presented in Table 5.

Table 5. Revision of Teaching Materials

Validator	Before Revision	After Revision
Media Expert	- Add an illustrative image to the cover - Fix the concept map - Transfer from Canva to Word - Add a description of the *ALQURUN teaching model* syntax	- Add illustrations to the cover - The concept map layout has been improved - Teaching materials were transferred from the Canva app to Word - Addition of : Explanation of the *ALQURUN teaching model*

Validator	Before Revision	After Revision
Subject Matter Expert	- Addition of material in the *Literature* stage - Addition of material on elements of algebraic expressions	- Addition of material in the *Literature* stage - Addition of material on elements of algebraic expressions

Table 5 shows the revisions made to the developed instructional materials. Input from media experts for the revision included adding illustrations to the cover, improving the concept map, transferring the teaching materials from the Canva application to *Microsoft Word*, and adding a description of the syntax from *the ALQURUN teaching model*. Input from media experts for the revision included adding material to the *literature* stage and adding material on the elements of algebraic expressions. The improvements to the cover are shown in Figure 2.

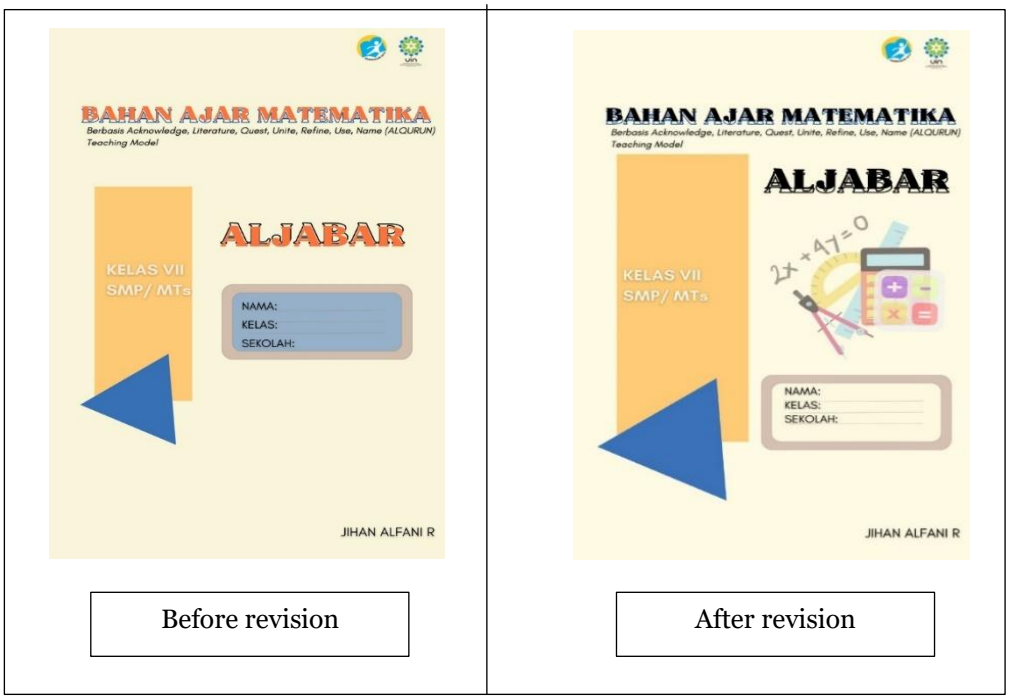


Figure 2. Revisions to the cover

Figure 2 shows the cover image before and after revision. The cover before revision did not include any illustrations related to the instructional material. After revising the cover, an illustration related to algebra was added, the red font was changed to black, and the blue column in the student identification section was removed. The improvements to the concept map are shown in Figure 3.

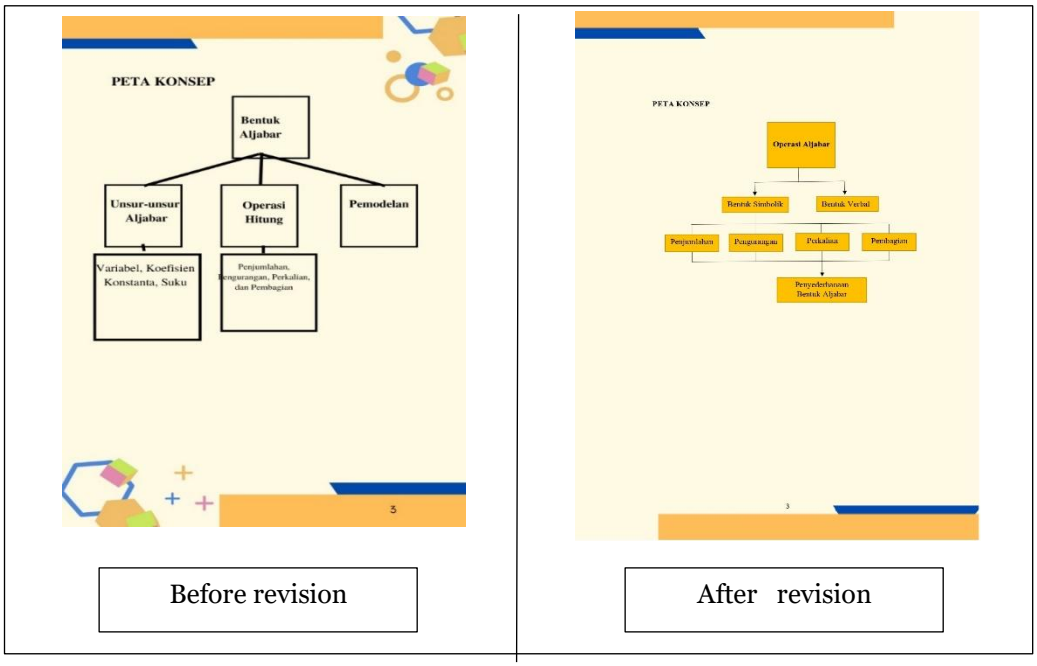


Figure 3. Improvements to the concept map

Figure 3 shows improvements to the concept map. Before revision, the diagram was not neatly organized and the font styles were inconsistent; after revision, the concept map became more organized and was aligned with the textbook used at the school. Furthermore, improvements to the core competencies and basic competencies are shown in Figure 4.

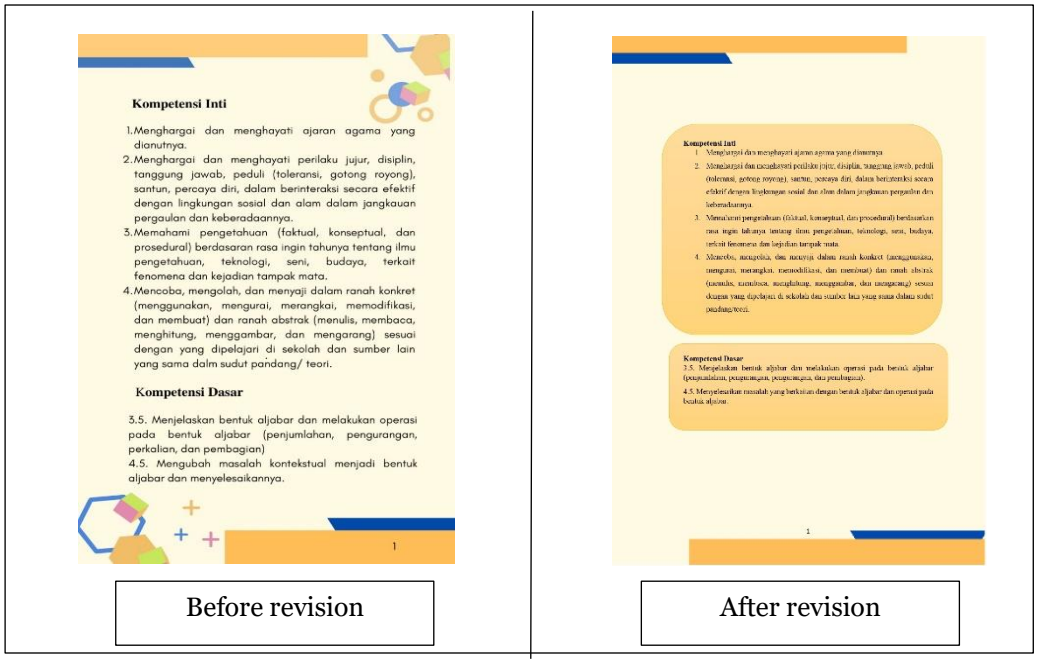
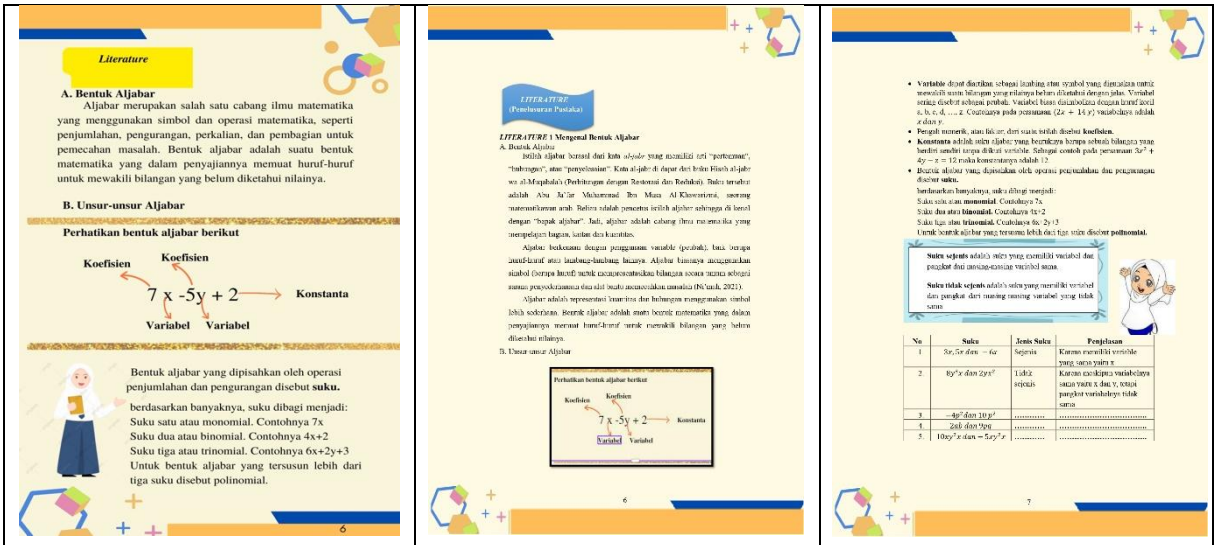


Figure 4. Improvements to core competencies and basic competencies

Figure 4 showing the conversion of content originally created in Canva to *Microsoft Office Word*. Before the revision, the fonts in the instructional material tended to be disproportionately large, and the pages were not neatly formatted because they were created manually. After the revision, the font in the teaching materials can be adjusted, and the pages can be formatted automatically and more proportionally. One of the improvements to the material can be seen in Figure 5.



Before revision	After revision

Figure 5. Improvement in the algebraic expression material

Based on Figure 5, the presentation of the material on algebraic expressions prior to revision appeared incomplete because it consisted of only one definition; furthermore, the definitions of each element of an algebraic expression ( ) had not been explained. After revision, a reference to the definition of an algebraic expression was added, and the elements of the algebraic expression were explained. For the definitions of like and unlike terms, columns and cartoon animations of Muslim women were added to make the content more engaging.

3.1.4 Implementation phase

The teaching materials developed were implemented with seventh-grade students at Al-Mas'udiyah Integrated Junior High School, Bandung Regency, West Java. The learning process using these materials was conducted over three sessions. The material presented in each session was as follows: learning activities 1) Understanding algebraic expressions, elements, and algebraic addition and subtraction operations; 2) Multiplication of algebraic expressions; 3) Division of algebraic expressions. After each learning activity using the *ALQURUN teaching model*-based mathematics teaching materials, students were given a test of their mathematical problem-solving skills consisting of two essay-type questions.

3.1.5 Evaluation phase

After the implementation of the *ALQURUN teaching model*-based mathematics teaching materials was completed, the evaluation stage followed. In this stage, an analysis was conducted of the assessment results by validators and student response questionnaires regarding the

mathematics teaching materials. Subsequently, the results of this analysis revealed the quality *of the ALQURUN teaching model*-based mathematics teaching materials in supporting the learning process.

Based on the evaluators' assessment, the mathematics teaching materials based on *the ALQURUN teaching model* received a "very good" rating. Furthermore, *these materials* also received a very positive response from students. In addition, the mathematics teaching materials were effective in supporting the mathematics learning process, as evidenced by the fact that the majority of students achieved the minimum passing grade or higher, in accordance with the school's standards.

3.2 Validity of the ALQURUN teaching model-based mathematics teaching materials

The evaluation of the *ALQURUN teaching model*-based mathematics teaching materials was conducted in two stages by both media experts and subject matter experts. Overall, the results of the expert evaluation are presented quantitatively in Table 6.

Table 6. Validation Test Results

No.	Validator	Average score for stage 1	Criterion	Average Score for Stage 2	Criteria
1	Media expert	52	Fairly valid	82	Very valid
2	Subject matter expert	61	Fairly valid	84	Highly valid
Overall average score		56.5	Fairly valid	83	Highly valid

Table 6 shows the average scores from media experts and content experts in stages 1 and 2. In the second stage, media experts obtained an average score of 82 with a "highly valid" rating, and content experts obtained a score of 84 with a "highly valid" rating. Thus, it can be concluded that, from the perspective of media and material presentation in the " " as assessed by media and content experts, the developed instructional materials are highly valid and suitable for use as a reference in mathematics instruction on algebra topics in schools.

3.3 The effectiveness of mathematics teaching materials based on the ALQURUN teaching model

The effectiveness of the mathematics teaching materials was assessed based on the average post-test scores for students' mathematical problem-solving skills. Teaching materials are considered effective if they have a positive impact on a specific learning objective (Annisa & Fitria, 2021) . The results of the effectiveness assessment, including the number of students who met the proficiency criteria, are presented in Table 7.

Table 7. Research Results on Effectiveness

Number of students who met the criteria	16
Effectiveness percentage	80
Effectiveness criteria	Effective

Table 7 shows the number of students who achieved mastery on the post-test of mathematical problem-solving skills. The instructional material was implemented with 20 seventh-grade students. The effectiveness was determined based on the results of the students' mathematical problem-solving ability test, 16 students achieved mastery, meaning the effectiveness rate was 80%. Based on this, the *ALQURUN teaching model*-based mathematics instructional material for improving students' mathematical problem-solving ability has met the criteria for effectiveness.

The following is one of the students' answers from the mathematical problem-solving test administered after the use of the teaching materials. The answer shown is a sample of the students' responses to question one. The answer can be seen in Figure 6.

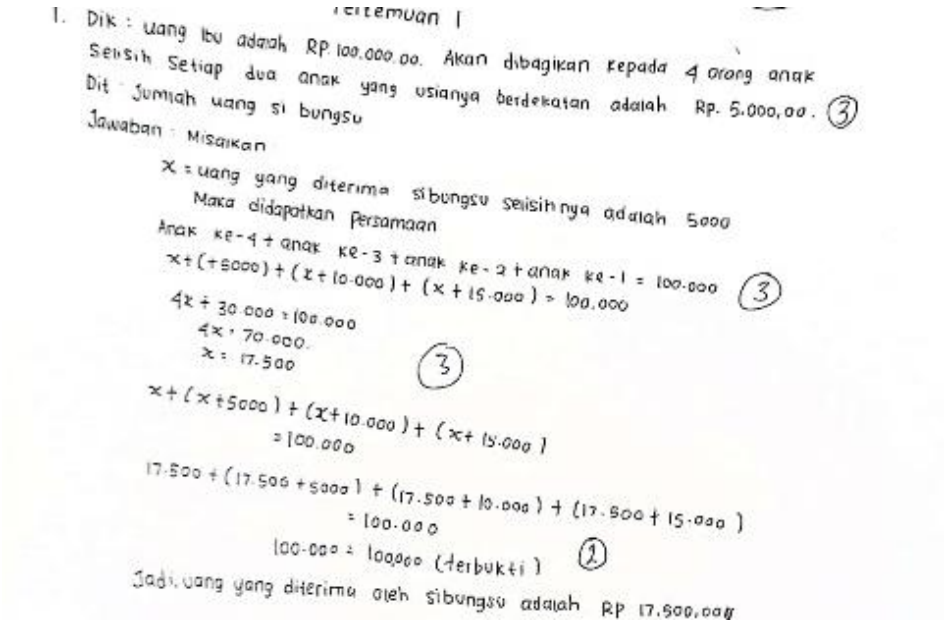


Figure 6. One of the students' answers

Figure 6 shows one of the answers from a student in the high-achieving group. The student's answer to question one achieved the maximum score because the student was able to understand the problem by writing down what was known and what was being asked; the student met the indicators for problem planning and problem solving effectively. The student also checked the answer again until the word "proven" appeared in the response.

3.4 *Student responses to mathematics teaching materials based on the ALQURUN teaching model*

A student response questionnaire was administered to determine students' reactions or responses to mathematics teaching materials based on *the ALQURUN teaching model.* The results of the student response questionnaire are shown in Table 8.

Table 8. Results of the Student Response Questionnaire

No.	Aspect	Statement number	Response score

1	Sense of joy	1, 2, 3	90
2	Curiosity	4	88
3	Interest	5	86
4	Activity	6, 7, 8	87
5	Satisfaction	9, 10	88
Average Response Score			88
Criteria			Excellent

Table 8 shows the results of the student response questionnaire scores, where the aspect of enjoyment includes statement items 1, 2, and 3; the aspect of curiosity includes statement item 4; the aspect of interest includes statement item 5; the aspect of activity covers items 6, 7, and 8, and the aspect of satisfaction covers items 9 and 10. The results of the student response questionnaire in a bar chart can be seen in Figure 7.

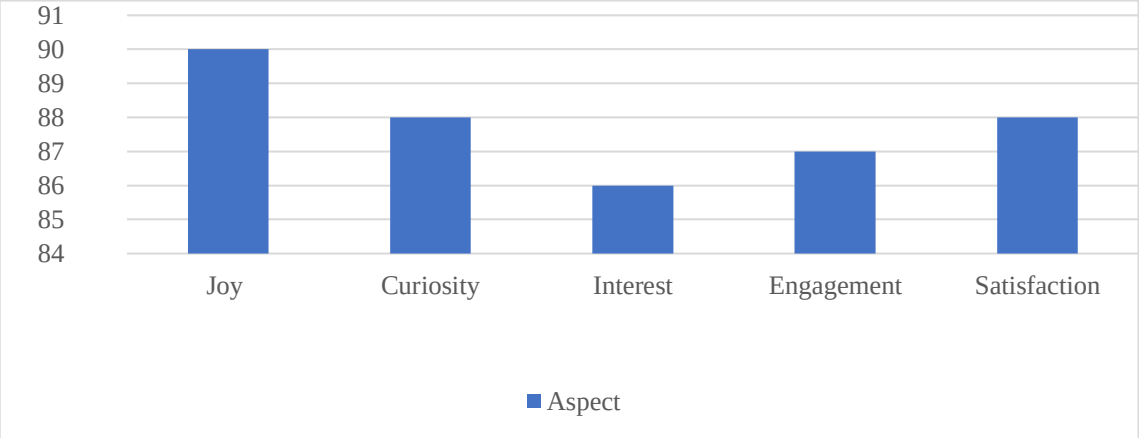


Figure 7. Results of the student response questionnaire

Figure 7 shows that the aspect of enjoyment received a response score of 90, indicating that students' responses during lessons, discussions, and after learning using the *ALQURUN teaching model*-based mathematics teaching materials met the "very good" criterion. The curiosity aspect received a response score of 88, indicating that students' curiosity was stimulated by the questions and problems in the *ALQURUN teaching model*-based mathematics teaching materials, meeting the "very good" criterion. The interest aspect received a score of 86, indicating that students' interest in using the *ALQURUN teaching model*-based mathematics teaching materials for other subjects met the "very good" criterion. The activity aspect received a response score of 87, indicating that students' active engagement which involves feeling enthusiastic about the subject matter, taking an active role in learning, and being able to summarize the material without the teacher's guidance achieved the "very good" criterion when using the *ALQURUN teaching model*-based mathematics instructional materials. The satisfaction aspect received a score of 88, indicating that students' responses regarding satisfaction made it easier for them to understand the material and that they felt satisfied.

4. Discussion

This study aims to develop mathematics teaching materials based on the *ALQURUN* teaching model to improve students' mathematical problem-solving skills. Based on the

research results, the main finding is that the developed teaching materials have a very high level of validity, are effective in improving learning outcomes, and received a very positive response from students. The validation results showed an improvement from the "moderately valid" category in the initial stage to "highly valid" after revisions were made, indicating that the teaching materials met the standards of suitability in terms of both content and media. Additionally, the effectiveness test results showed that 80% of students achieved learning mastery, classifying the instructional materials as effective. Student responses also yielded very positive results with an average score of 88 (excellent category), reflecting a high level of engagement and acceptance of the developed instructional materials.

These findings are essentially in line with expectations (expected results), given that, theoretically, problem-based learning and structured instructional materials can enhance students' mathematical problem-solving skills. This aligns with Polya's (1973) view that problem-solving ability develops through systematic stages: understanding the problem, planning a solution, executing the plan, and reviewing the results. The ALQURUN framework, consisting of *Acknowledge, Literature, Quest, Unite, Refine, Use, and Name*, conceptually supports these stages. Furthermore, the ALQURUN framework has strong connections to *Problem-Based Learning (PBL)*, *Realistic Mathematics Education (RME/PMRI)*, and digital literacy, which emphasize the importance of authentic contexts, culture, and real-world relevance in mathematics learning (Amalia & Wiratomo, 2019; Chong et al., 2019; Mughal et al., 2021; Spyropoulou et al., 2020). The integration of cultural contexts and real-world experiences in learning has been shown to enhance student motivation, engagement, and the transfer of knowledge to everyday life situations (Freeman-Green et al., 2021; Wright et al., 2021; Starčič et al., 2023). In this context, ALQURUN-based instructional materials serve not only as a medium for delivering content but also as a tool for developing 21st-century competencies such as critical thinking, collaboration, and digital literacy (Mendrofa, 2024; Wijaya et al., 2024).

However, the effectiveness of implementing the ALQURUN teaching model depends on several supporting factors, such as teachers' professional competence, a collaborative culture at school, and the quality of the tasks assigned to students. The literature indicates that problem-based learning models lacking clear implementation guidelines risk causing student confusion or fostering reliance on technology without deep conceptual understanding (Basir & Maharani, 2017; Ramsay-Jordan, 2022). Therefore, reinforcement through teacher training (*professional development*) and continuous evaluation is necessary to ensure the model's sustainability and effectiveness in the long term, particularly in enhancing metacognition and the transfer of problem-solving skills (Gutstein, 2003; Urlaub & Dessein, 2024).

However, there are several findings that can be categorized as unexpected results. One of these is the high level of student response in the affective domain, such as feelings of joy, curiosity, and satisfaction, which reached the "very good" category. Although previous research has shown that engaging instructional designs can enhance learning motivation (An, 2020), the exceptionally high response levels in this study indicate that ALQURUN-based instructional materials not only impact cognitive aspects but also significantly enhance students' emotional engagement. Additionally, the improvement in problem-solving skills within a relatively short period is a notable finding, given that prior literature suggests the development of such skills typically requires a longer timeframe (Wright et al., 2021).

When compared to previous studies, the results of this study reveal both similarities and differences that add value. The similarity lies in the finding that problem-based learning and contextual instructional materials can improve students' mathematical problem-solving skills (Ahyansyah et al., 2020; Ariawan & Zetriuslita, 2023). However, the main distinction of this study lies in the explicit integration of the learning model into the instructional material design. Most previous studies merely applied the learning model during the teaching process without integrating it into the structure of the instructional materials. In this study, the ALQURUN syntax is an integral part of the instructional materials, enabling students to independently follow a systematic line of reasoning. Additionally, the inclusion of the *Literature* and *Name* stages in ALQURUN offers a novel contribution to mathematics education, particularly in developing students' mathematical literacy and communication skills (Suherman et al., 2019; Mendrofa, 2024).

The success of ALQURUN-based instructional materials in enhancing mathematical problem-solving skills can be explained through several theoretical approaches. First, from a constructivist perspective, learning that actively involves students in constructing knowledge leads to deeper understanding (Clements et al., 2023). The stages in ALQURUN, particularly *Quest* and *Unite*, encourage students to explore and integrate ideas both independently and collaboratively. Second, from a metacognitive perspective, the *Refine* and *Name* stages allow students to reflect on and evaluate their thinking processes, thereby enhancing metacognitive awareness, which plays a crucial role in problem-solving (Wright et al., 2021). Third, from an instructional design perspective, improvements in visual presentation, concept maps, and systematic material structure enhance the readability and appeal of instructional materials, which ultimately impact students' learning motivation (An, 2020).

Additionally, the research context also influences the obtained results. Students' limited access to digital learning resources makes this instructional material their primary learning source, thereby optimizing its use. This indicates that the effectiveness of instructional materials is influenced not only by internal design but also by students' external conditions. In other words, ALQURUN-based instructional materials can address learning needs in specific contexts, particularly in environments with limited technological access.

Nevertheless, this study has several methodological limitations that need to be noted. First, the relatively small sample size (20 students) limits the generalizability of the research findings. Second, the implementation duration, which lasted only three sessions, was insufficient to measure the long-term impact on students' mathematical problem-solving skills. Third, the validation process involved only one media expert and one content expert, so the potential for subjectivity remains possible. Fourth, this study employed a quantitative descriptive approach without a control group, making it impossible to fully establish a causal relationship between the use of instructional materials and improvements in students' abilities. Therefore, future research is recommended to use an experimental design with a control group and involve a larger and more diverse sample.

Despite these limitations, the results of this study have fairly broad implications and can be generalized to a limited extent. Theoretically, this study contributes to the development of mathematics learning designs by systematically integrating the ALQURUN model into instructional materials. Practically, these instructional materials can serve as an alternative for teachers in implementing student-centered learning, particularly in schools with limited

learning resources. The principles in ALQURUN, such as problem-based learning, reflection, and the integration of literature, are universal in nature and thus have the potential to be applied across various levels of education and other learning contexts. Thus, although this study was conducted within a limited context, the findings obtained still hold broader relevance for the development of 21st-century mathematics education.

5. Limitations and future research

This study has several limitations that should be acknowledged. First, the study involved a relatively small sample size and was conducted within a limited educational context, which may restrict the generalizability of the findings to broader populations and different learning environments. Second, the implementation of the developed instructional materials was limited to short-term classroom intervention; therefore, the long-term impact of the ALQURUN teaching model on students' mathematical problem-solving skills, mathematical literacy, and metacognitive development has not yet been comprehensively examined. Third, the study primarily focused on algebra learning at junior high school level, limiting the applicability of the findings to other mathematical topics and grade levels.

Future research is recommended to involve larger and more diverse samples across different schools and educational settings to enhance the external validity of the findings. Further studies may also investigate the long-term effectiveness and sustainability of the ALQURUN-based instructional materials through longitudinal or experimental research designs. In addition, future researchers are encouraged to integrate digital technologies, such as interactive learning platforms, virtual learning environments, or artificial intelligence-based tools, to optimize the implementation of the ALQURUN teaching model in technology-enhanced mathematics learning. Moreover, further exploration of the model's influence on other higher-order thinking skills, such as critical thinking, creative thinking, and mathematical reasoning, would provide broader insights into its pedagogical potential.

6. Conclusion

This study concludes that the development of mathematics teaching materials based on the ALQURUN teaching model using the ADDIE model has proven to be valid, effective, and has received an excellent response from students, making it suitable for use as an innovative alternative in mathematics education, particularly for enhancing mathematical problem-solving skills in algebra. The implications of this study indicate that the integration of the ALQURUN syntax is capable of fostering more structured, contextual learning that is oriented toward strengthening mathematical literacy, metacognition, and students' active engagement in higher-order thinking processes. Furthermore, the results of this study provide practical contributions for teachers in designing systematic and student-need-based instructional materials, as well as theoretical contributions to the development of problem-based learning models integrated with literacy and reflection.

Author Contributions

Jihan Alfani Rahmasari: Conceptualization, methodology, formal analysis, investigation, data curation, writing—original draft preparation. Juariah: Validation, supervision, writing—

review and editing. Hamdan Sugilar: Conceptualization, supervision, visualization, writing—review and editing.

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