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Development of student worksheets with react strategy to facilitate students' mathematical literacy skills in an islamic context

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Abstract
In the 21st century, mathematical literacy skills are among the most crucial competencies for students. However, current levels of student proficiency in this area remain suboptimal. This study aims to develop REACT strategy teaching materials that incorporate Islamic context mathematical literacy questions on the topic of algebraic function limits. The development model used in this study is the ADDIE model, which comprises five stages: Analyze, Design, Development, Implementation, and Evaluation. The test subjects in this study included expert validators consisting of three mathematics education lecturers from UIN Syarif Hidayatullah Jakarta, five high school mathematics teachers, and one high school Islamic religion teacher. Additionally, a limited trial was conducted with 30 grade XII MIPA students at SMA Muhammadiyah Sawangan. The instruments used in this study included expert validation instruments, student response questionnaires, and Islamic context mathematical literacy ability tests. The results indicated that the REACT strategy teaching materials developed achieved a high level of validity, with a validation score of 0.89 from expert evaluators. The level of practicality was also high, with a score of 0.93, indicating very feasible criteria based on student response questionnaires. The developed teaching materials were considered effective in facilitating mathematical literacy skills in the Islamic context, based on an average test of student learning outcomes against the Minimum Competency Standards – Kriteria Ketuntasan Minimal (KKM), with a student success rate of 63%. The conclusion of this study is that the REACT strategy teaching materials designed to enhance students' mathematical literacy skills in the Islamic context, specifically on the topic of function limits, have met the quality standards for teaching materials in terms of validity, practicality, and effectiveness, making them suitable for classroom use.

Keywords: Function limits, Islamic context, Mathematical literacy, REACT strategy, Student worksheets

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Introduction

Mathematics is the discipline that studies numbers and calculations. According to a survey conducted by (Sharma, 2021) a significant portion of respondents agree that mathematics has a wide range of applications in various aspects of life. Similarly, (Dewaik et al., 2020) stated that mathematics can be used as a strategy for performing numerical and algebraic calculations in various scientific fields such as physics, engineering, chemistry, and

biology. The ability to tackle problems in various life aspects through mathematics is known as mathematical literacy (Abidin et al., 2021) Therefore, mathematical literacy is an essential knowledge area that individuals need to master due to its relevance to various other fields in daily life.

Mathematical literacy is the ability to understand the function of mathematics in real life and to use it to make decisions and live purposefully (Rizki & Priatna, 2019). According to the Report of the Expert Panel on Student Success in Ontario, mathematical literacy is a prerequisite for achieving success in life, as it supports individuals in making informed decisions about life problems and participating actively in social activities (The Report of the Expert Panel on Student Success in Ontario, 2004). The international organization PISA (Programme for International Student Assessment) 2021 defines mathematical literacy as the ability to think mathematically, as well as to formulate, use, and interpret mathematics to solve problems in various real-world contexts. This encompasses concepts, procedures, facts, and tools to describe, explain, and predict situations, and helps individuals understand the role of mathematics in the world, making assessments and decisions required by constructive, engaged, and reflective citizens in the 21st century (OECD, 2018).

The PISA 2021 framework identifies mathematical literacy through three interrelated aspects: reasoning and problem-solving (process), content, and context. The process has three main indicators: formulating, employing, and interpreting, which illustrate how individuals connect contextual problems with mathematical solutions (OECD, 2018). Content in mathematical literacy is divided into four categories: change and relationships, space and shape, quantity, and uncertainty and data. Context is also divided into four categories: personal, occupational, societal, and scientific. The context is important as it allows individuals to relate their interests to various possible situations in the 21st century (OECD, 2018). This demonstrates that mathematical literacy is an essential part of an individual's ability to function effectively in real life

The observed data indicates that students' mathematical literacy skills are not yet optimal. According to a 2022 survey by PISA focusing on mathematical literacy, Indonesian students are categorized as low in proficiency. Indonesia ranked 70th with a score of 366 out of 81 participating countries. Besides the PISA results, previous research also reflects similar findings, indicating that students' mathematical literacy skills in Indonesia remain low (Hardianti & Desmayanasari, 2022; Amelia et al., 2021; Kurniawati et al., 2021). Kurniawati et al. (2021) stated that one of the reasons students struggle to answer contextual problems is that they are not accustomed to high-level thinking demands. Given these findings, efforts are necessary to address and improve the low mathematical literacy skills among students.

Referring to Sulfayanti (2023) study on the factors and solutions related to students' low mathematical literacy, it was identified that one effective solution is the development of high-quality teaching materials to support mathematical literacy. By using and integrating diverse and appropriate teaching materials in the learning process, teachers can equip and help students enhance the necessary skills to face future challenges (Surwuy et al., 2023). In practice, most teaching materials used in schools do not yet fully facilitate the needs of students to improve their mathematical literacy. Dewantara (2019) research on the analysis of the K-13 textbook content related to mathematics for its potential to develop mathematical literacy indicated that the current K-13 mathematics textbooks are not yet maximized in

developing students' mathematical literacy skills. Aligning with these findings, interviews conducted by researchers with a mathematics teacher at a high school in Depok revealed similar concerns: the teaching materials currently in use do not focus on enhancing students' mathematical literacy skills. Therefore, there is a significant need for the development of teaching materials that can better facilitate students' mathematical literacy.

The development of current teaching materials is quite diverse, with some incorporating specific models, approaches, or strategies to meet students' needs. Given the ongoing challenges in students' mathematical literacy, it is essential to develop teaching materials that address this issue effectively. One such approach is applying the REACT learning strategy to teaching materials. Several studies have shown the positive impact of integrating the REACT strategy with the ADDIE model in developing teaching materials aimed at improving students' mathematical literacy skills (Faizah et al., 2022). REACT stands for Relating, Experiencing, Applying, Cooperating, and Transferring (Crawford, 2001). It is an active learning strategy that encourages students to engage in a series of learning activities, transforming them from passive recipients to active participants. This strategy helps students understand concepts, discover, build, and experience them directly (Halim et al., 2018).

In line with the aforementioned points, Rohaeti et al. (2019) define the REACT learning strategy as one that emphasizes student engagement in activities such as exploring, collaborating in groups, and applying new knowledge to various situations and conditions. The Center of Occupational Research and Development (CORD) describes REACT as a contextual learning strategy (Crawford, 2001). The Ministry of National Education interprets the contextual approach as one that links learning materials to real-life problems, encouraging students to integrate their prior knowledge with real-world applications (Ariani et al., 2019). By employing the REACT strategy, students become accustomed to solving contextual problems, applying, and adapting various types of knowledge, including modifying formulas they have learned. Therefore, the REACT strategy plays a crucial role in enhancing students' mathematical literacy skills.

Integrating Islamic values into mathematics education offers numerous positive aspects, not only in shaping students' obedience and good moral character but also within the context of mathematics itself. Islamic values can be incorporated into mathematics learning in various ways. These methods include consistently mentioning the name of Allah, using terms combined with Islamic values, employing visual illustrations with Islamic nuances, inserting relevant Quranic verses or hadith, exploring topics connected to Islamic teachings, and utilizing symbols from the natural universe (Fitrah & Kusnadi, 2022). Furthermore, integrating Islamic principles into mathematics education can enhance students' mathematical abilities by increasing their motivation to learn (Maqruf & Ulpah, 2020; Rahmi et al., 2023). Consequently, the integration of Islamic context in mathematics can positively influence both students and the learning process itself.

As a subject with relatively low achievement levels, some mathematical topics in SMA/MA class XI are deemed more challenging for students to understand compared to others. One such topic is the algebraic function limit material. This is supported by previous research findings, which indicate that students' lack of mastery in algebraic function limits is a major factor preventing them from solving related problems (Dewi et al., 2020; Robiah, 2020). These findings suggest that students' understanding of algebraic function limits

remains insufficient, highlighting the need for efforts to improve their comprehension of this material.

Numerous studies have been conducted on the development of teaching materials using the REACT strategy. For example, Maiviyani et al. (2018) researched the development of learning devices using the REACT strategy, finding that student activity reached 91.25% and student success rates reached 70%. Agustin & Fuad (2022) examined student worksheets based on the REACT strategy for quadrilateral material, resulting in worksheets that were valid, practical, and effective, with an average response percentage of 89.4% and 78% on the classical study completeness test. Additionally, Sihite & Pangaribuan (2023) explored the Jigsaw cooperative model with the REACT strategy, concluding that it effectively enhanced students' mathematical problem-solving abilities and learning activities. Despite these studies, none have focused on developing teaching materials with the REACT strategy to facilitate mathematical literacy within an Islamic context. Therefore, the objective of this study is to develop teaching materials using the REACT strategy to facilitate mathematical literacy within an Islamic context, specifically for the topic of function limits.

Methods

This study employs the Research and Development (R&D) method. The product to be developed in this research is teaching materials in the form of student worksheets utilizing the REACT strategy to facilitate mathematical literacy within an Islamic context, specifically on the topic of function limits. The development of these teaching materials follows the ADDIE model (Figure 1), which comprises five stages: Analyze, Design, Development, Implementation, and Evaluation.

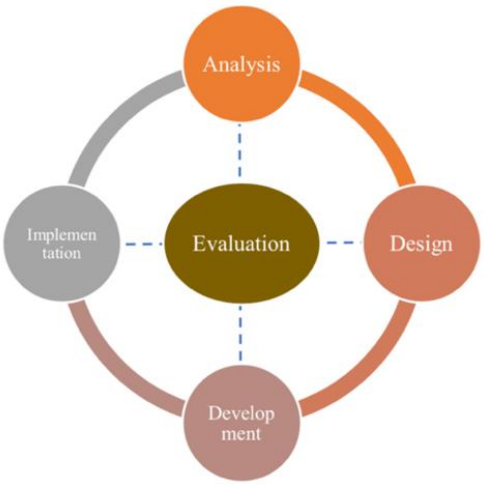


Figure 1. The ADDIE Model for Product Development

The test subjects in this research are divided into two categories: expert trials and field trials. The expert trial involved three mathematics education lecturers, five mathematics teachers, and one religious education teacher. The field trial was conducted with 30 grade XII MIPA students from SMA Muhammadiyah Sawangan, who had previously studied algebraic function limits.

Data collection techniques in this study consist of three components: expert validation instruments, student response questionnaires, and mathematical literacy ability tests. The expert validation instruments were administered to assess the validity of the developed teaching materials, while the student response questionnaires were used to evaluate the practicality of these materials. The mathematical literacy tests were given to students after implementing the teaching materials to determine their effectiveness in enhancing students' mathematical literacy skills.

Both the expert validation instruments and student response questionnaires used a Likert scale. The collected data were analyzed using Aiken's V formula. The validity and practicality of the teaching materials were determined based on the criteria in Table 1.

Table 1. Criteria for Validity and Practicality of Teaching Materials

Index	Criteria
$V > 0{,}8$	Very Practical
$0{,}4 < V \leq 0{,}8$	Practical
$V \leq 0{,}4$	Less Practical

Source: (Retnawati, 2016)

The instrument test in this study consists of five questions, each representing an activity related to an indicator of mathematical literacy skills. The test data analysis was performed by calculating the percentage of students who achieved the Minimum Competency Standards – *Kriteria Ketuntasan Minimal* (KKM). The criteria for the effectiveness of teaching materials in facilitating students' mathematical literacy can be seen in Table 2.

Table 2. Criteria for Effectiveness of Teaching Materials

Completeness	Category
$X > 80\%$	Very Effective
$60\% < X \leq 80\%$	Effective
$40\% < X \leq 60\%$	Fairly Effective
$20\% < X \leq 40\%$	Less Effective
$X \leq 20\%$	Ineffective

Source: (Kharisma & Sugiman, 2017)

Teaching materials are deemed valid and practical if they fall within the "worthy" criteria, with a coefficient ranging between 0.4 and 0.8. Teaching materials are considered effective if the number of students scoring above the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)* value is significantly higher than those scoring below it.

Result

Analyzing Stage

The analysis stage is conducted to gather the necessary information and components required for compiling teaching materials. In this study, the analysis stage is divided into two parts: needs analysis and curriculum analysis. The needs analysis was performed through interviews with mathematics teachers and several high school students. Based on the interview results, it was found that the teaching materials used in the classroom consist of mathematics textbooks and PowerPoint presentations made by the teacher, which are very limited. This limitation results in the unavailability of teaching materials that focus on

developing students' mathematical literacy skills. Additionally, the exercises provided to students are still classified as routine questions sourced from mathematics textbooks and do not cover real-life contextual issues. The integration of Islamic values in mathematics learning is also minimal, as there are still limited mathematical study sources that incorporate Islamic values. Furthermore, based on the interview results with students, it was found that the concept of function limits is considered one of the most challenging topics for students. The difficulties encountered by students in this material are diverse, including understanding properties and calculation operations. Moreover, the teaching materials used by teachers in class have not yet maximized students' understanding.

Curriculum analysis was conducted to determine materials based on competence achievement that aligns with school needs. The curriculum used by the schools for the class subject in this study is the 2013 curriculum. The sub-materials used in the teaching materials include the concept of function limits, properties of function limits, the continuity and discontinuity of function limits, limits at infinity, and the rate of change. This curriculum information was also used by researchers to formulate the Indicator of Competency Achievement (IPK) with reference to the Basic Competencies (KD) stipulated in the Minister of Education and Culture Regulation Number 37 of 2018 for function limit material in class XI. Here are the KD and IPK for the function limit material (see Table 3).

Table 3. KD and IPK on Function Limit Topic

Basic Competencies	**Indicator of Competency Achievement - *Indikator Pencapaian Kompetensi* (IPK)**
3.7 Explaining the concept of algebraic function limits (polynomial and rational functions), their intuitiveness and properties, and determining their existence	3.7.1 Identifying the meaning of function limits at a certain point 3.7.2 Determining the limit value of a function at a certain point through direct substitution 3.7.3 Determining the left-hand and right-hand limits of a function 3.7.4 Determining the properties of algebraic function limits 3.7.5 Determining the limit values of continuous and discontinuous algebraic functions. 3.7.6 Determining the limit value at infinity for algebraic functions. 3.7.7 Determining the limit value of indeterminate forms for algebraic functions. 3.7.8 Determining the rate of change at a certain moment for algebraic functions using the concept of function limits
4.7 Solving problems related to algebraic function limits	4.7.1 Solving contextual problems related to everyday life using the concept of function limits at a certain point 4.7.2 Solving contextual problems related to everyday life using the properties of function limits 4.7.3 Solving contextual problems related to everyday life using the concept of continuous and discontinuous function limits 4.7.4 Solving contextual problems related to everyday life using the concept of limit at infinity 4.7.5 Solving contextual problems related to everyday life using the concept of rate of change in algebraic functions

Designing Stage

The design stage involves creating teaching materials based on the results of the needs and curriculum analysis conducted in the previous stage. Activities in this design stage include structuring the teaching materials and preparing assessment instruments. The structure of the teaching materials is developed by designing components included in the

student worksheets, which comprise the cover, identity, foreword, table of contents, usage instructions, competencies, concept maps, materials and exercises, answer keys, scoring guidelines, glossary, and bibliography.

Furthermore, the learning activities are arranged according to the stages in the REACT strategy as follows:

1. Relating: This stage includes presenting a problem illustration in the form of a story with an Islamic context. Students are asked to read and understand the presented problem.
2. Experiencing: This stage involves several questions leading to activities that help students discover concepts related to the current material being studied. Students will explore their prior knowledge related to the material, allowing them to build their understanding independently.

Here, teaching materials (see Figure 2) are provided for the Relating and Experiencing stages of the REACT strategy.

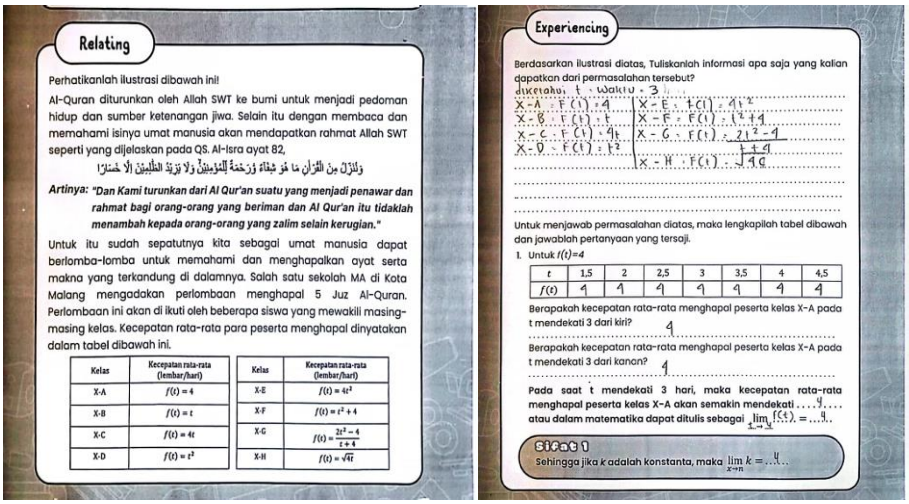


Figure 2. The Relating and Experiencing Stages on Student Worksheets with the REACT Model

3. Applying: This stage includes guiding questions that prompt students to solve the problems identified in the Relating stage by applying the concepts they discovered in the Experiencing stage.
4. Cooperating: This stage involves guiding questions that encourage students to confirm their answers with their peers. Students are asked to collaborate and discuss with classmates to verify each of their answers.
5. Transferring: This final stage contains new problem illustrations designed to reinforce the knowledge that students have previously acquired.

Here, teaching materials (see Figure 3) are provided for the Applying, Cooperating, and Transferring stages in the REACT strategy.

Figure 3. Applying, Cooperating, and Transferring Stages on Student Worksheets with the REACT Model

The indicators of mathematical literacy skills used in this study include three key components: formulating, employing, and interpreting. Each of these indicators is related to the REACT learning strategy applied in this study. The design of the teaching materials, based on mathematical literacy components and the Islamic context, is depicted in Table 4.

Table 4. Design of Teaching Materials

Sub-material	Learning Activity	Islamic Context	Context	Content
Unit 1: The concept of function limits	*Relating* *Transfering*	Hadith Daily activities	*Personal* *Occupational*	*Change and Relationship*
Unit 2 Properties of function limites	*Relating* *Transfering*	Verses of the Al-Quran Sirah nabawiyah	*Personal* *Personal*	
Unit 3 Continuous and Discontinuous Forms	*Relating* *Transfering*	Daily activities Verses of the Al-Quran	*Occupational* *Personal*	
Unit 4 Limits at Infinity	*Relating* *Transfering*	Daily activities Verses of the Al-Quran	*Occupational* *Scientific*	
Unit 5 Rate of Change	*Relating* *Transfering*	Daily activities Verses of the Al-Quran	*Societal* *Scientific*	

The preparation of the assessment instruments is divided into three categories: expert validation instruments, test instruments, and student response questionnaires. Each of these instruments will be used to evaluate the quality of the teaching materials.

Development Stage

The development stage encompasses several key activities, including the creation of teaching materials, expert validation, and subsequent revisions. The teaching materials developed in this research are known as student worksheets. This student worksheets is arranged using a customized Canva application, adhering to the design established in the design stage. Figure 4 illustrates the cover (a) of the student worksheets and the table of contents (b) for all student worksheets materials related to function limits.

(a) (b)

Figure 4. The cover of module (a) and the table of content (b)

After the teaching materials were compiled into a complete draft, they were validated by three mathematics education lecturers from UIN Syarif Hidayatullah Jakarta, five high school mathematics teachers, and one Islamic religious education teacher at the SMA/MA level. The results of the validation conducted by these experts and practitioners are presented in Table 5.

Table 5. Expert Validation Results

No.	Aspect	Score	Criteria
1	Coverage of Material	0,88	Very Practical
2	Grammar	0.84	Very Practical
3	Presentation of Material	0,87	Very Practical
4	Graphics	0,92	Very Practical
5	Learning strategies to facilitate mathematical literacy in an Islamic context	0,88	Very Practical
6	Exercises	0,92	Very Practical
	Overall Evaluation	**0,89**	**Very Practical**

Based on Table 5, the developed teaching materials received highly suitable criteria from the experts across all aspects. This indicates that the REACT strategy teaching materials are valid for facilitating mathematical literacy and can be implemented for students after revisions based on the suggestions provided in the validation sheets.

In addition to expert validation of the material, validation by a religious expert was also conducted by an Islamic religious education teacher. This validation aimed to determine whether the Islamic values incorporated in the teaching materials were appropriate and accurate. The results of the validation by the religious expert indicated that the general Islamic context, including Quranic verses, Hadith, stories of prophets, and daily events, were appropriate and properly integrated into the learning materials. However, the researcher noted several necessary additions for further improvement of the teaching materials to enhance their quality.

Implementation Stage

Following the validation and revision process by experts, the developed teaching materials were implemented with students. The implementation stage involved 30 students from class XII MIPA. The objective of this implementation was to observe the students' responses to the teaching materials. These responses were collected through a student response questionnaire and a mathematical literacy test administered after the implementation of the teaching materials. Figure 5 illustrates the students' process in using the student worksheets on the function limit material.

Figure 5. The Relating Stage on Student Worksheets Using REACT as a Model

The assessment results of the practicality of the teaching materials, based on student questionnaire responses, are presented in Table 6.

Table 6. Student Questionnaire Response Results

No.	Aspect	Score	Criteria
1	Presentation of Material	0,93	Very Practical
2	Grammar	0.91	Very Practical
3	Graphics	0,94	Very Practical
4	Learning Strategies	0,94	Very Practical
5	Exercises	0,94	Very Practical
6	Benefit	0,92	Very Practical
	Overall Evaluation	**0,93**	**Very Practical**

Based on Table 6, the developed teaching materials received very positive criteria across all aspects. This indicates that, in general, students gave positive responses to the developed teaching materials, particularly regarding the appearance and design of the student worksheets.

The effectiveness of the teaching materials was assessed based on the results of a mathematical literacy test administered after the implementation of the teaching materials. Teaching materials are considered effective in enhancing mathematical literacy if the average score of students exceeds the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)*, set at 75, with a majority of students achieving this criterion. The total scores obtained by students are summarized in Table 7.

Table 7. Test Results

Score	Number of Students	Percentage
< 75	11	37%
≥ 75	19	63%
Total	**30**	**100%**

Based on Table 7, the REACT strategy teaching materials developed with Islamic context are deemed effective in facilitating students' mathematical literacy. This is demonstrated by the fact that more than 60% of the students achieved the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)*.

Evaluation Stage

Following the implementation stage, the researcher conducted an overall evaluation of the developed teaching materials. There were several notes regarding the duration of the learning sessions, which were found to be somewhat rushed in each meeting. Additionally, certain stages required adjustments, as some instructions were not sufficiently clear for students to understand.

Discussion

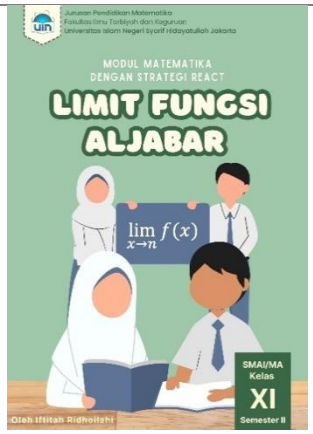
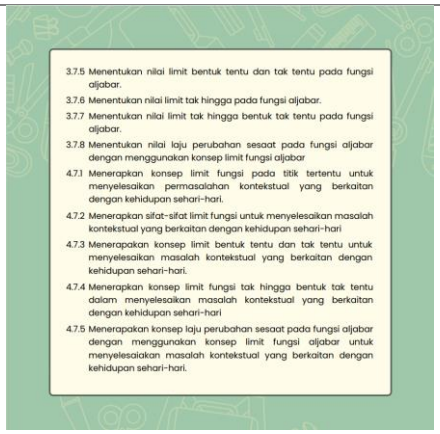
The teaching materials are organized to apply the stages of the REACT learning strategy. This strategy is related to each indicator of mathematical literacy. The stages of relating (associating) and experiencing have a connection to the achievement of mathematical literacy abilities on the indicators of formulating, which refer to the ability to understand and identify opportunities to apply mathematics, as well as to structure mathematics to solve a problem. The applying stage is related to the achievement of mathematical literacy on the indicators of employing, which refers to the ability to apply concepts, procedures, and mathematical reasoning to find solutions to problems. The stages of cooperating (working together) and transferring are connected with the indicators of interpreting, which refer to the ability to evaluate solutions, results, or mathematical conclusions and interpret them in real-life contexts.

Validation results indicate that the developed teaching materials fall into the very worthy or very valid category, with an average Aiken V index score of 0.89. The Islamic context used is also appropriate and proper. However, there are several notes provided by the researchers based on the validation results. These are presented in Table 8.

The results of the student questionnaire response indicate that the developed teaching materials achieved an average Aiken V index of 0.93, classifying them as very suitable or highly practical. The highest Aiken V score was in the aspect of graphics, with a score of 0.94, while the lowest score was in the aspect of grammar, with an average score of 0.91. In general, students gave positive responses to the developed teaching materials, particularly regarding the appearance and design of the student worksheets. This is consistent with previous studies on the development of teaching materials using the REACT strategy, which also obtained very suitable criteria (Nur'aliyah, 2022; Fitriani & Andriani, 2020). Based on the results of the mathematical literacy ability test, 63% of students scored above the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)* of 75, while 37%

scored below the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)*. These results suggest that the teaching materials can be categorized as good. This demonstrates that the developed teaching materials are effective in facilitating students' mathematical literacy. This finding aligns with research conducted by (Nurafni et al., 2020; Putri et al., 2020; Prabawati et al., 2019), which shows that the development of teaching materials is effective in enhancing students' mathematical literacy. Other research also supports this result, indicating that teaching materials developed using the ADDIE model, such as e-modules (Nabila et al., 2024) and digital learning materials positively impact students' mathematical literacy skills (Imtiyaaz, 2023; Amelia et al., 2021).

Table 8. Expert Validation Results on Student Worksheets for Limit and Function Material

No	Validation Results	Before Revision	After Revision
1	Page sections cover need additional information related to the compiler's name, agency, and class.		
2	Indicators need to be adjusted to match the problem-solving level of KD 4.7.		
3	It would be better if the Hadith used were accompanied by their numbers.		

Conclusion

Based on the results and discussions, the researcher concluded that the REACT strategy teaching materials for facilitating mathematical literacy in an Islamic context meet the validity criteria in the "very feasible" category, with an average Aiken V index of 0.89, and the practicality criteria in the "very feasible" category, with an Aiken V score of 0.93. The teaching materials are considered effective in enhancing mathematical literacy if the average score of students in the mathematical literacy test is greater than the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)* of 75, with a majority of students achieving this criterion. The percentage of students who scored above the Minimum Competency Standards – *Kriteria Ketuntasan Minimal (KKM)* was 63%.

Declarations

Author Contribution : RM: Conceptualization, Methodology, Writing - Review & Editing.
DK: Validation, Writing - Review & Editing, Visualization.
EN: Investigation, Formal analysis, Writing - Original Draft.
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Additional Information : No additional information.

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