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Development of Contextual Numeracy Literacy Tool based on 21st Century Skills in MI Al-Ishlah Kota Sorong Southwest Papua

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Abstract

The numeracy literacy skills of madrasah students are still relatively low, while the challenges of the 21st century demand mastery of critical thinking, problem solving, and logical thinking skills in the context of real life. This study aims to develop and analyze the effectiveness of numeracy literacy learning tools integrated with 21st century skills at MI Al-Ishlah Sorong City. The device development uses the Plomp model which consists of five phases: initial investigation, design, realization/construction, test-evaluation-revision, and implementation. The results of the needs analysis showed that the device was needed by teachers (85%) and students (86.7%). Expert validation showed that the device met the eligibility criteria, with a language validation score of 80.25%, media 91.4%, and content 88.6% and 86.4%. The practicality of the device was rated high based on the responses of learners (86.17%) and teachers (85.17%), and in accordance with the audio- visual learning style of learners. The effectiveness of the module was tested with a one-group pretest- posttest design. The results showed a significant increase in the mean score from 57.95 to 80.6, with an N-Gain of 0.69. This device is proven to be able to improve the understanding of numeracy concepts as well as critical and creative thinking skills of learners. This study concludes that the device developed is valid, practical, and effective, and is recommended to be applied in learning as an innovative effort in strengthening numeracy competence in the 21st century learning era.

Keywords: *Madrasah Ibtidaiyah, 21st Century Skills, Module, Learning Effectiveness.*

Introduction

Quality education is the main pillar in forming a superior generation that is able to compete

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globally. All elements of education - learners, parents, teachers, policy makers, and government - see the importance of learning that not only emphasizes academic achievement, but also builds critical, creative, collaborative and communicative thinking skills according to the demands of the 21st century. In this context, numeracy literacy occupies a strategic position as a fundamental competency that needs to be instilled from an early age. Numeracy literacy not only reflects the ability to understand numbers and mathematical operations, but also the skills in applying these concepts in real life in a logical and meaningful way [1].

The Ministry of Religious Affairs of the Republic of Indonesia through the Directorate General of Islamic Education has initiated the Indonesian Madrasah Competency Assessment (AKMI) as an effort to measure and improve the basic literacy of madrasah students, including numeracy literacy [2]. AKMI is designed to answer the need for a more comprehensive and authentic assessment, replacing the role of the National Examination which has been emphasizing on the mastery of material aspects. In its implementation, AKMI not only tests the achievements of students, but also provides a comprehensive picture of the learning process and environment that occurs in madrasah. One of the results of AKMI in 2022 showed that most students in MI Al-Ishlah Kota Sorong were still at the proficient level, indicating the need for intervention through the development of more relevant and contextual learning tools.

Numeracy literacy is closely related to mathematical competence, but emphasizes the application of concepts and understanding in the context of everyday life [3]. This shows that learning approaches that are too focused on memorizing mathematical formulas and procedures have not been able to equip students with adaptive numeracy skills. In fact, the results of the Program for International Student Assessment (PISA) in 2018 noted that the average numeracy score of Indonesian students only reached 379, far below the average of ASEAN countries [4]. This finding reinforces the urgency of the need for innovation in mathematics learning, especially in the aspect of numeracy literacy, so that students are able to develop higher-level thinking skills more systematically and contextually.

The quality of learning cannot be separated from the role of teachers in designing learning tools that are adaptive and responsive to the needs of students. Unfortunately, many teachers still face challenges in developing learning tools that are integrated with the characteristics of students and the times. The tools used still tend to be textual and monotonous, do not consider the different learning styles of students, and do not optimally support the development of 21st century skills [5]. In fact, in this digital era, learners tend to have visual and auditory learning styles that demand learning media that are interactive, interesting, and relevant to their lives.

Good teaching materials not only convey content informatively, but also function as a learning facilitation tool that allows learners to build understanding independently and collaboratively. Teaching materials must be able to bridge between learning materials and the real world of students, as well as facilitate the development of higher order thinking skills [6]. Therefore, the development of teaching materials based on numeracy literacy integrated with 21st century skills is a strategic step to answer the challenges of learning in madrasah, while supporting national policies in improving the quality of basic education.

In addition, the successful implementation of AKMI also depends on teachers' readiness to use the assessment results as the basis for lesson planning. The AKMI report card can be used as a reference in developing more personalized and adaptive learning strategies, including in choosing materials, media, and learning methods. In this case, the development of valid, practical, and effective learning tools is a crucial first step to improve the teaching and learning

process. These learning tools not only need to meet pedagogical standards, but also accommodate the needs of students and support the achievement of 21st century learning indicators.

Considering this background, this research focused on the development of numeracy literacy learning tools integrated with 21st century skills at MI Al-Ishlah Sorong City. The development was conducted through a Research and Development (R&D) approach using the Plomp Model which is systematic and comprehensive, including the stages of needs analysis, design, construction, evaluation, and implementation. The purpose of this research is to produce learning tools that are feasible to use (valid), easy to apply in learning (practical), and able to improve student learning outcomes (effective), especially in the context of numeracy literacy.

This research is expected to make a significant contribution to the development of mathematics learning in madrasah, as well as a reference for teachers and education stakeholders in designing innovative, relevant and contextual learning strategies. In addition, the tools developed are also expected to strengthen the integration between numeracy literacy and 21st century skills, so that students are not only academically proficient, but also able to adapt to the dynamics of present and future life.

Method

This study used a research and development (R&D) approach by referring to Plomp's development model, which includes five main phases: (1) preliminary research, (2) design,

(3) realization/construction, (4) test, evaluation, and revision, and (5) implementation [7]. In this study, the development process is focused on the fourth phase, namely the formative evaluation stage, which aims to produce Problem Based Learning (PBL)-based numeracy literacy learning tools that are integrated with 21st century skills and have been tested from the aspects of validity, practicality, and limited effectiveness.

Preliminary Research

This stage begins with a learning needs assessment conducted through observations in several madrasah ibtidaiyah (MI), interviews with teachers, as well as documentation study of curriculum documents, national assessment results (AKM), and relevant literature on numeracy literacy and PBL learning. The aim was to identify gaps between the current implementation of numeracy learning and the demands of 21st century skills.

Design

In the design stage, researchers develop learning devices which include:

Learning Implementation Plan (RPP)

Contextualized teaching materials

Learner Activity Sheet (LAS)

Numeracy literacy assessment instrument

All tools are designed by integrating PBL syntax, namely: problem orientation, organization of learning, independent/group investigation, development and presentation of work, and analysis and evaluation of the problem solving process [8]. Emphasis is also given to the integration of 4C skills (Critical Thinking, Collaboration, Communication, and Creativity) [9].

Product Construction

At this stage, researchers developed an initial version of the device based on the design results. This device was then consulted with expert lecturers as initial reviewers (informal reviewers) before entering the formal validation stage. The product includes:

Lesson plans that adopt Merdeka Curriculum learning outcomes for phase E (SMA).

Contextual problem-based LAS designed to stimulate higher order thinking skills.

The numeracy literacy assessment is in the form of structured description questions, adopting AKM indicators and referring to numeracy domains such as: data representation, graph interpretation, proportion, and probability.

Test, Evaluation, and Revision

Expert Validation

Validation was conducted by three mathematics education experts who assessed four main aspects:

- Content validity
- Device construction
- Readability and language
- Suitability with PBL model and 21st century skills

The validation instrument used a 4-point Likert scale, and the data was analyzed using the validity level formula as follows:

$$V = \frac{\sum X}{\text{N x } 4}$$

Where:

- $\sum X$ = total score of all validators
- N = number of statements
- 4 = maximum score for each statement.

The interpretation of the validity level refers to the criteria: highly valid (0.81-1.00), valid (0.61-0.80), moderately valid (0.41-0.60), less valid (0.21-0.40), and invalid (≤0.20).

Practicality Test

The device was tested for practicality through training and simulation of distance learning (PJJ**)** to MI teachers from various regions, namely:

- MI Al-Ishlah Sorong City
- MI in Purbalingga Regency
- MI in Pasuruan Regency

The training was conducted through the Zoom platform and followed by the distribution of a practicality questionnaire to measure teacher perceptions of the ease of use, clarity of

instructions, and usefulness of the device. The practicality score was calculated using the formula:

$$Kepraktisan = \frac{\sum X}{\text{N x } 4}\ x\ 100\%$$

The interpretation of the results refers to the criteria: very practical (≥85%), practical (70-84%), quite practical (55-69%), and less practical (<55%).

Effectiveness Test

The effectiveness test was conducted through a limited simulation with trainee teachers, using contextual numeracy questions based on AKM indicators. Changes in participants' abilities before and after training were analyzed using normalized gain (Hake, 1998) as follows:

$$g = \frac{(\text{Posttest} - \text{pretest})}{(100 - \text{pretest})}$$

The value of g is interpreted as follows:

- Height: $g \geq 0.7$g ≥ 0.7
- Medium: 0.3 ≤g<0.7
- Low: $g < 0.3$

In addition, researchers used descriptive statistical tests and significance tests (Wilcoxon test for non-parametric data) to assess the effectiveness of improving learning outcomes.

Results and Discussion

Results

This research aims to develop numeracy literacy learning tools integrated with 21st century skills, through the 4D development model approach (Define, Design, Develop, and Disseminate) [10]. The whole process is carried out in a gradual and structured manner to ensure that the tools produced are not only relevant to today's learning needs, but also meet quality standards from the aspects of validity, practicality and effectiveness.

The development process begins with a preliminary study through identification of field needs, including curriculum analysis, learner characteristics, and actual learning conditions in elementary schools. The information obtained from this stage is the basis for designing devices that are responsive to the needs of learners as well as adaptive to the challenges of 21st century education. After the initial design was developed, the device was validated by experts to ensure the feasibility of its content, construction, and integration. The practicality test was conducted through the involvement of teachers as direct users of the device in the classroom. Furthermore, the effectiveness test was carried out through limited implementation to assess the impact of the device on improving students' numeracy literacy skills. Each stage is reported systematically to provide a comprehensive picture of the quality of the developed tools, as well as showing the integration between aspects that support the achievement of learning objectives.

Initial Investigation in Learning Design Development

Initial investigation is a crucial stage in the development of learning design, which aims to explore the real needs in the field as the basis for developing contextual and relevant learning

tools. In this research, the initial investigation includes several important aspects

related to the characteristics of learners, the condition of teachers, and the context of the applicable curriculum.

First, an analysis of the learner level shows that most learners still have difficulty in understanding basic mathematical concepts in the context of everyday life. This has a direct impact on the low numeracy literacy skills, which should be a basic competency in supporting the mastery of various subjects. This low level of ability is reinforced by the diverse social and cultural backgrounds of the learners, where most come from environments with limited access to quality learning resources, both in terms of economic aspects, family literacy and learning culture at home.

Furthermore, investigations show that learners' prior knowledge of 21st century skills

- which include critical thinking, creativity, collaboration and communication - is low. These skills have not yet become part of their learning habits, both in the school environment and outside. In fact, these skills are an important key in facing the challenges of an increasingly complex and dynamic era.

Another aspect identified is that learners' learning styles and aptitudes vary widely. Some learners show visual tendencies, others auditorial or kinesthetic. These differences necessitate flexible learning strategies that are able to accommodate various individual needs, so that the learning process becomes more meaningful and empowering.

An investigation was also conducted into teachers' needs, where it was found that teachers still need systematic guidance in integrating 21st century skills into mathematics learning. Most teachers find it difficult to design learning activities that involve higher-order thinking processes and active participation of learners, and are still limited in the use of authentic assessment in accordance with the demands of the curriculum.

Analysis of the curriculum illustrates that structurally, mathematics learning has great potential to be integrated with numeracy literacy and 21st century skills. However, this integration has not been fully realized practically in the lesson plan documents or the implementation of learning in the classroom.

In response to these findings, a learning stimulus, innovative lesson plan design and assessment instruments were designed that not only assess basic cognitive skills but also capture learners' critical thinking, cooperation and communication skills in solving contextual problems. All these components were developed based on the results of field investigations to align with the real needs of learners and teachers.

Concept map related to the Preliminary Investigation stage

A concept map is a visual representation that depicts the initial steps in the development research or design research process. This stage focuses on the initial exploration and identification of problems that form the basis of product or solution development. In this concept map, several elements are included including needs analysis, literature study, field observation, stakeholder interviews, and identification of gaps between actual and ideal conditions. The relationship between these elements is shown through connecting lines that reflect the interrelationship between one aspect and another, thus helping researchers to systematically understand the factors that influence the development of a particular product or model.

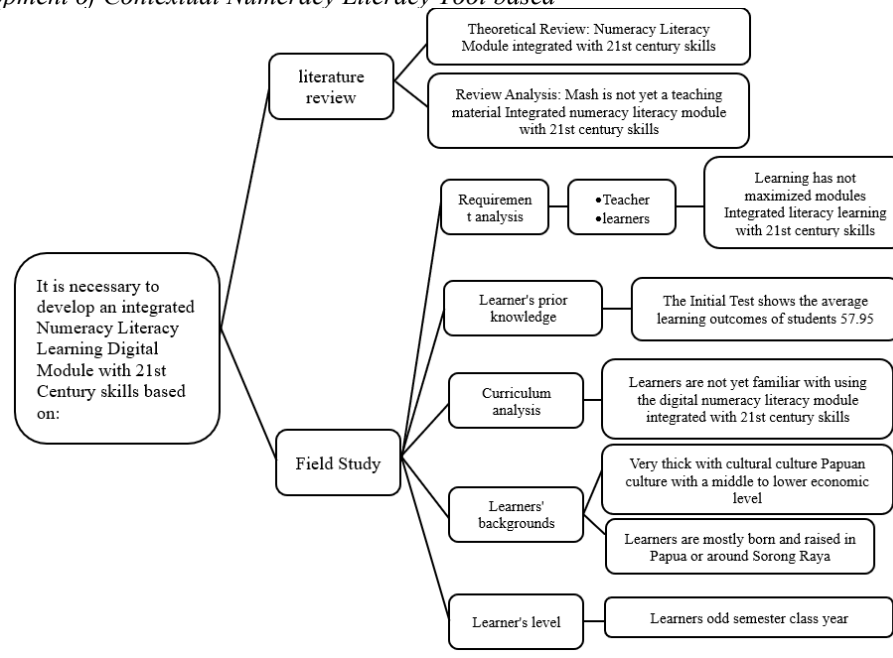

Figure 1. Concept Map Related to the Stages of Plimenary Investigation

Device Development Design

Design Phase

At this stage, an integrated numeracy literacy module with 21st century skills (4C: critical thinking, creativity, collaboration, communication) was developed. The module was developed in two versions: print and digital. The digital module is an interactive flipbook equipped with voice narration, links and video content to support learners' understanding.

Instructions for Teachers: Teachers access the digital module through the link, use the flipbook and audio features, and guide learners in its use and discussion of the material.

Instructions for Learners: Learners read the module, listen to the narration, access additional content, and work through the interactive exercises.

Advantages of Digital Modules: Flexible, engaging, and supports multimodal learning through text, audio, and video.

Realization/Construction Phase

This stage produces Prototype 1 in the form of an initial module design based on the results of the analysis of learning needs and curriculum. Module components include:

Cover and Table of Contents: Display the identity and structure of the module content in a neat and professional manner.

Module Description: Explains the purpose, benefits and integration of numeracy literacy with 21st century skills.

Digital Storyboard: Visualization of digital modules, including screen displays, navigation, audio, video, and interactive elements. Developed using the Heyzine platform.

Numeracy Literacy Learning: Presents concepts, the importance of numeracy literacy, and contextual activities that encourage learners to think critically and work together.

This stage also includes the preparation of validity, practicality, and effectiveness instruments as a basis for developing the initial draft of teaching materials.

Device Validity Level

The validation process of learning tools and research instruments is a crucial stage in the development of tools based on the 4D model, especially in the define, design and develop phases. This validation aims to assess the feasibility and suitability of the device with the characteristics of 21st century learning and the integration of numeracy literacy in the context of mathematics subjects. The assessment was conducted by experts with expertise in mathematics education, learning design and assessment. The validated aspects include the suitability of content, construction, language, and integration of learning outcomes and learner characteristics.

Table 1. presents a recapitulation of the validation results of several main components of learning devices, namely lesson plans, teaching materials, LKPD, and assessment instruments. Each component was validated by three experts using a four-point scale, then analyzed to obtain the average value of validity and its feasibility category. The values obtained show that all devices are in the "very valid" category, so they are suitable for use in the practical test and limited implementation stages.

No	Komponent/ Instrument	Validator/Asessment Aspect	Average Score	Ideal Value	Category, Conclusion
1	Teaching Material (Module)	Linguist – Dr. Fardan Abdillah	3.21	4	Feasible, minor revisions
		Media Expert – Dr. Muhammad Faturahman	4.57	5	Feasible, minor revisions
		Material Expert – Dr. Arie Anang Setyo	4.43	5	Feasible, minor revisions
		Material Expert – Dr. Rahmatullah bin Arsyad	4.32	5	Feasible, minor revisions
	Module Validation Average		4.13		Worth to using
2	Initial Observation Sheet	Relevance of indicators, instructions, content, format	3.65	4	Very Valid
3	Learner Needs Analysis	Literacy needs, 21st century, presentation, completeness	3.65	4	Very Valid
4	Teacher Needs Analysis	Literacy relevance, 21st century, completeness, clarity	3.70	4	Very Valid
5	Learning Outcome Question Sheet	Indicator, construction, clarity, appropriateness	3.65	4	Very Valid

6	Learner Response Questionnaire	Instructions, language, content	3.70	4	Very Good
7	Teacher Response Questionnaire	Instructions, language, content	3.70	4	Very Good
8	One-to-One Evaluation	Learner suggestions (illustrations, colors, sample problems)	-	-	Need aesthetic & content revision
9	Small Group Evaluation (10 leaarnes)	7 pernyataan terkait efektivitas dan keterlibatan	88.57%	100%	Good – Very Good
	- Material as needed		92%		Very Good
	- Teaching materials are interesting & easy to understand		88%		Good
	- Encourages critical thinking		80%		Good
	- Improving communication		84%		Good
	- Helps understand numeracy literacy		96%		Very Good
	- Illustrations support learning		92%		Very Good
	- Contextual tasks		88%		Good

Table 1. Recapitulation of Validation Results of Learning Devices and Instruments

Practicality of Learning Devices

The learning devices are tested through limited implementation in the classroom. Teachers were given brief training and monitored during use. Evaluation was conducted through observation, posttest, and interview to assess the ease of use, affordability, and suitability of the device. Practicality data in table 2 was collected from questionnaires and analyzed based on teacher and learner responses. The results showed a very positive response to all aspects.

Aspects	**Number of Items**	**Average Score (Learners)**	**Average Score (Teacher)**	**Average Percentage (%)**
Can Motivate	5	3,32	3,33	83,00
Interest	4	3,48	3,47	86,75

Material and Presentation	7	3,35	3,36	84,00
Language Usage	4	3,48	3,36	85,38
Numeracy Literacy	2	3,58	3,43	87,63
21st Century Skills (4Cs)	4	3,46	3,49	86,75
Average Total		3,45	3,40	85,67

Table 2. Results of Data Analysis of Teacher Response and Learner Response

Effectiveness of Device Development

To measure the effectiveness of the developed learning tools, a limited implementation was conducted for students with a focus on the achievement of numeracy literacy and 21st century skills, which include critical thinking, creative thinking,

collaboration and communication. The evaluation of effectiveness is conducted comprehensively through three main aspects, namely learning implementation, achievement of learning outcomes, and students' subjective responses to the learning process.

The implementation of learning was analyzed through observation of teacher and student activities during the learning process. Students' learning outcomes were evaluated through the comparison of pre-test and post-test scores to calculate quantitative ability improvement using the N-Gain index. The aspects of 21st century skills were assessed through specific indicators, such as the ability to formulate problems, generate alternative solutions, and the quality of cooperation and communication during the learning process. Students' responses to the learning process were assessed through a closed questionnaire with a Likert scale.

Overall, the results of the analysis show that the learning tools developed are able to improve the effectiveness of learning both in terms of process and results. The summary of quantitative data related to the effectiveness of learning devices is presented in Table 3 below.

Aspects Analyzed	**Indicator/Parameter**	**Key Results**	**Category/Conclusion**
Learning Implementation	Planning, Implementation, Evaluation, Involvement	Average score 2-4, majority score 3-4, student engagement varies	Good enough, needs improvement on student participation and reflection
Critical Thinking Skills	Problem identification, Solution strategy, Solving	Total average 2.30 (57.52%)	Critical Enough
Creative Thinking Skills	Many ideas, New ideas, Alternative solutions	Total average 1.49 (37.25%)	Medium / Needs Improvement
Collaboration and Communication Skills	Teacher & student response to learning	Average score 3.42-3.47 (85.5%-86.75%)	Very good

Learning Outcome (Pre-test)	Initial value	Average 57.95	Fair, showing limited initial understanding
Learning Outcome (Post-test)	Value after learning	Average 80.6	Significant increase
Improvement (N-Gain)	Comparison of pre-test & post-test	Average 0.69 - medium to high category, none low	Effective

Table 3. Summary of Learning Device Effectiveness Analysis Results

Discussion

Learning Design Development Needs Level Analysis

Needs analysis is a fundamental early stage in the process of developing learning tools, as it provides a strong basis for ensuring that the tools developed are in line with the real needs in the field [11]. Based on the results of the preliminary study, it was found that numeracy literacy learning in elementary schools has not been optimally integrated with 21st century skills. Observations and interviews with teachers show that the learning approach

used is still dominantly oriented towards mechanistic procedures and memorization, while skills such as critical thinking, collaboration, communication, and creativity have not been adequately facilitated in learning activities [9].

The gap between the demands of the Merdeka Belajar curriculum and its implementation in the classroom is evident. The curriculum encourages competency-based learning that emphasizes strengthening literacy and numeracy in real-life contexts and developing the Pancasila learner profile. However, teachers admit that they have difficulty in designing learning that is able to systematically integrate numeracy literacy with 21st century skills [12]. In addition, the results of diagnostic assessments of learners show that their numeracy skills tend to be below the national average, especially in solving contextual and reasoning problems.

This data indicates an urgent need to develop learning tools that not only emphasize mastery of numeracy content, but are also able to foster 21st century skills simultaneously. This approach is in line with the principles of innovative learning design that integrates cognitive aspects and life skills in a unified learning whole [13]. Therefore, the results of this needs analysis provide a solid basis for developing a contextualized, transformative, and adaptive numeracy literacy learning design for 21st century challenges.

Learning Device Development Design

The process of developing numeracy literacy learning tools integrated with 21st century skills in this study refers to the 4D model which consists of the stages of Define, Design, Develop, and Disseminate [10]. This model was chosen because of its ability to guide the development of devices systematically, starting from the needs analysis to the product testing and refinement stage. In the define stage, the characteristics of learners, curriculum demands, and learning context analysis are identified. This information becomes the basis for device design in the next stage.

The design stage involves developing a competency framework, formulating learning objectives, developing contextual problem-based activities, and selecting media and authentic assessment

instruments that support the strengthening of numeracy literacy and 21st century skills in an integrated manner. The learning design is developed using problem- based learning and project-based learning approaches, which are proven to be effective in building critical thinking, collaboration and communication skills [14]. Emphasis is placed on activities that encourage learners to explore data, make estimates, solve real problems, and reflect on their thought processes.

The assessment instrument is designed not only to measure the final results, but also to monitor the learning process of learners through formative assessment that integrates the 21st century skills rubric. The lesson plans (RPP) and learner activity sheets (LAPD) developed have gone through a validity test process by experts, so they have a strong scientific basis for implementation. The design of this tool is oriented towards meaningful, participatory and contextual learning, which is expected to bridge the gap between conventional numeracy learning and the needs of 21st century global competencies [15].

Analysis of Learning Device Validity

The validity of learning tools is an important indicator in determining the quality and feasibility of a learning product before it is implemented in the classroom. In this context, validity refers to the extent to which the device developed can measure and facilitate the

achievement of learning objectives accurately and consistently [16]. The validity assessment is conducted by experts consisting of mathematics education lecturers, learning device development experts, and experienced teachers. The validated aspects include the suitability of the content with the curriculum, clarity of learning objectives, integration of numeracy literacy with 21st century skills, and meaningfulness of learning activities.

The assessment results show that the learning device is highly valid with a high average score in all aspects assessed. This indicates that the device has met the content and pedagogical standards set out in the Merdeka Belajar curriculum, and has the potential to be widely applied in contextual numeracy learning. This validation also shows that the design of learning activities is able to integrate the development of 21st century skills such as critical thinking, problem solving, and collaboration, in accordance with the global competency framework [17].

Furthermore, the toolkit demonstrates consistency between objectives, materials, methods and assessments which are important principles in constructivistic-based learning design [18]. The high content validity provides assurance that this tool can be used as a valid guide in the learning process that demands mastery of numeracy literacy as well as character development and 21st century life skills. Therefore, the results of the validity analysis strengthen the argument that this tool is ready to proceed to the implementation and practicality stages.

Learning Device Practicality Analysis

The practicality of learning tools refers to the ease of use by teachers in the real context of the classroom as well as the functionality of each component in supporting the learning process [19]. In this study, practicality was evaluated through a limited trial involving teachers as the main users of the device. The aspects assessed include readability, completeness of components, ease of implementation, and suitability of learning activities to the classroom context. Teachers gave a positive response to the device developed, especially on the clarity of the activity steps, flexibility of use, and relevance of the material to the daily lives of students.

The practicality test results show that the device is in the very practical category, both in terms

of design and implementation. Teachers stated that this tool helps them to design learning that is more structured, meaningful, and encourages active participation of learners. The problem- and project-based learning activities designed in the toolkit make it easier for teachers to relate numeracy material to real-life situations, as well as train learners to work together and communicate effectively - two key skills in 21st century learning [20] [21].

In addition, it provides a more authentic and reflective assessment alternative, wzzhich makes it easier for teachers to comprehensively assess learning processes and outcomes. Practicality is also evident from the flexibility of the device in being adapted to classroom conditions and student characteristics. This finding is in line with Jan den Akker's (1999) opinion that a practical learning tool should be able to be operated smoothly by target users, without the need for substantial modifications [22]. Thus, the high level of practicality strengthens the feasibility of the device to be widely used in an effort to improve the quality of numeracy literacy learning based on 21st century skills.

Learning Device Effectiveness Analysis

The effectiveness of learning tools is assessed by the extent to which they are able to improve students' learning outcomes and develop 21st century skills simultaneously. In this study, effectiveness is measured through limited implementation in the classroom using a quasi-experimental design, and refers to indicators of increased numeracy literacy, learning activities, and critical thinking skills of students. The results of the analysis showed that there was a significant increase in students' numeracy achievement after using the developed tools, both in terms of concept understanding, reasoning ability, and contextual problem solving.

Furthermore, the tools are also effective in facilitating the development of 21st century skills such as collaboration, communication and creativity. The open-ended and project-based learning activities provide space for students to work in teams, discuss, express opinions, and develop creative solutions to real problems. This shows that a contextual and learner-oriented learning approach can create a more active and meaningful learning environment [8].

The effectiveness of this device is also reinforced by observation data and performance assessment sheets, which show that students show improvement in the aspects of participation, initiative, and reflection during the learning process. This finding is in line with the opinion of Darling-Hammond et al. (2020) who emphasized that learning that supports 21st century skills should engage students in activities that are complex, challenging, and relevant to their lives [23]. Therefore, the developed device is proven to be not only valid and practical, but also effective in improving the quality of numeracy learning that is integrated with the demands of global competence.

Conclusion

The numeracy literacy learning tools developed using the 4D model approach (Define, Design, Develop, Disseminate) have met the criteria of feasibility and effectiveness to be used in the learning process. The results of the needs analysis show that students and teachers need a device that is able to bridge numeracy literacy mastery with the strengthening of 21st century skills, especially the ability to think critically, collaborate, and solve problems. The device design is systematically designed by considering the interrelationship between learning objectives, contextual numeracy content, active learning strategies, and authentic assessment. The high validity of the toolkit is reflected in the experts' assessment that the toolkit is appropriate to the curriculum, pedagogically relevant, and has a logical and cohesive structure and content. The

practicality of the device was also proven to be very good based on teachers' responses which stated that the device was easy to understand, could be implemented flexibly, and was able to increase students' engagement in learning. Furthermore, the device showed significant effectiveness in improving students' learning outcomes. Learning using this tool proved to be able to encourage the improvement of students' numeracy literacy and foster essential 21st century skills in facing global challenges. Overall, the toolkit is not only theoretically and technically feasible, but also contributes significantly to improving the quality of learning in the classroom in practical terms.

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Conflicts of Interest

The authors declare that there is no conflict of interest

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