p-ISSN: 2086-4280
e-ISSN: 2527-8827

Development of STEAM- Project Based Learning Module to Improve Numeracy Literacy of Upper Elementary School Students

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Article received: 12-05-2025, revision: 22-06-2025, published: 30-07-2025

Abstrak

Tujuan penelitian yaitu mengembangkan modul STEAM berbasis Project Based Learning (PjBL) untuk meningkatkan literasi numerasi peserta didik kelas tinggi. Penelitian pengembangan model Borg and Gall ini mengadopsi 7 langkah yaitu research and information collecting, planning, develop preliminary from of product, preliminary field testing, main product revision, main field testing, operational product revision. Subjek penelitian yaitu peserta didik kelas IV SD meliputi 3 peserta didik pada uji one to one, 10 dalam uji small group, dan 26 dalam uji coba lapangan. Analisis kelayakan produk diperoleh dari hasil isian angket oleh ahli media, materi, bahasa, dan peserta didik pada skala one to one dan small group. Sedangkan analisis efektivitas diperoleh dari hasil pretest dan post test pada uji coba lapangan. Hasil uji validasi ahli media 98.5%, ahli materi 96% yang berarti produk sangat layak. Dari ahli bahasa diperoleh penilaian 76% termasuk kategori layak. Pada uji one to one diperoleh hasil 86% dan pada small group 90% termasuk kategori sangat layak. Hasil pretest dan post test pada uji coba lapangan diuji paired sample t-test. Diperoleh hasil 0.98 untuk pretest dan 0.97 untuk post test dengan p < .001, sedangkan N-Gain diperoleh yaitu 0.61 yang mana termasuk dalam kategori sedang. Dapat disimpulkan modul STEAM berbasis PjBL dapat meningkatkan literasi numerasi peserta didik kelas tinggi.

***Kata Kunci**: Literasi Numerasi; PjBL; Sekolah Dasar; STEAM.*

Abstract

This research aims to develop a STEAM-based Project Based Learning Instructional Module to improve numeracy literacy in upper-grade students. This developmental research using the Borg and Gall model, adopting seven steps: research and information gathering, planning, preliminary product developing, preliminary field testing, main product revising, main field testing, and operational product revising. The subjects were fourth-grade elementary school students: 3 students in the one-to-one test, 10 in the small-group test, and 26 in the field trial. The feasibility analysis was obtained from questionnaires completed by media, material, and language experts, as well as students on a one-to-one and small-group scale. The effectiveness analysis was obtained from the pretest and posttest results. The validation test results from the media expert were 98.5% and the material expert 96%, indicating the product was very feasible. The language expert received a 76% rating, categorizing it as feasible. In the one-to-one test, the results were 86% and in the small group, 90%, including the very feasible category. The results of the pretest and posttest in the field trial were tested the paired sample t-test. The results obtained were 0.98 for the pretest, and 0.97 for the posttest with p < .001, while the N-Gain obtained was 0.61 which is included in the moderate category. It can be concluded that the STEAM-based PjBL Instructional Module can improve the numeracy literacy of Upper Elementary School Students.

Keywords: Numeracy Literacy; PjBL; Elementary School; STEAM.

I. INTRODUCTION

There has been a remarkable advancement in information and communication technologies in all areas of life in the 21st century. Many jobs that humans do now may no longer be needed in the future. Therefore, to face the current 21st-century globalization, students need new skills (Fernandez & Romero, 2020). One of the skills that must be mastered in the 21st century is numeracy literacy. Numeracy literacy is managing numbers and data and evaluating statements based on situations and reality (Sari, 2016). The scope that builds numeracy literacy consists of basic mathematical materials, including geometry, algebra, arithmetic, and data processing (TIM GLN Kemendikbud, 2017).

Unfortunately, the numeracy literacy rate in Indonesia is still relatively low, even though numeracy literacy has an important urgency to understand the complex problems of the 21st century (Salma & Mudzanatun, 2019) (Prihandoko, 2021). The results of the 2018 PISA survey revealed that Indonesia's score in mathematics was below average, with a score of 379 lower than 489 participants of the Organization of Economic Co-operation and Development (OECD). The OECD stated that 71% of students' mathematics scores did not reach the minimum mathematics competency score (Deda et al., 2023) (Suprapto et al., 2020). This condition shows that students have limitations in using their mathematics skills in everyday life.

Many factors contribute to low numeracy literacy in Indonesia, one of which is the low ability of teachers to create mathematical problems in learning (Rika et al., 2019). In line with that, the results of observations on grade IV students of SDN Kanigoro found that teacher guidance was needed regarding reading in mathematics lessons because students still found it difficult to receive information (Mauza et al., 2022). Lack of teacher guidance in implementing mathematics learning can confuse students and make them unfamiliar with numeracy literacy's basic concepts. Teachers must strive so that students can understand complex mathematics learning that is packaged interestingly and differently. Various methods can be used, one of which is to facilitate students using teaching materials.

The teaching materials should cover various mathematical materials that are the basis for numeracy literacy. Teachers can apply the module by paying attention to writing content that includes solving mathematical problems with a background in everyday life, which is given in graphs, tables, numbers, and other mathematical symbols (Rakhmawati & Mustadi, 2022). A module is a teaching material prepared with a structured method and contains materials and reviews that can be used independently (Tjiptiany et al., 2016). The module can be facilitated with a learning approach to make them more effective in their application (Purniawan et al., 2022). The STEAM (Science, Technology, Engineering, Arts, Mathematics) approach can be applied to be combined with teaching materials.

STEAM is a style of thinking that encourages children to always be

p-ISSN: 2086-4280
e-ISSN: 2527-8827

interested in finding out, investigating, and finding answers (Siantajani, 2020).

STEAM is a development of the previously existing STEM (Science, Technology, Engineering, Mathematics) concept with the addition of art elements (Apriliana et al., 2018). Initially, the National Science Foundation (NSF) referred to STEM as SMET, which stands for Science, Mathematics, Engineering, and Technology (Sari, 2021). The addition of art elements in STEAM learning is important because of the increasingly advanced developments in the 21st century, so disciplines are needed that can better support students' ideas (Conradty et al., 2020). The STEAM approach can change the direction of future learning in an interactive context in today's era of development (Tan et al., 2021). STEAM can teach academic skills by developing intellectual abilities when students interact naturally with their surroundings (Katz-Buonincontro, 2018). Integrating several fields of knowledge in the STEAM approach can create integrated teaching, and students can implement the concepts in everyday life.

The STEAM approach, in its application, requires real problems encountered by students and requires solutions to overcome them with ideas and concepts through appropriate processes and flows. Therefore, this STEAM approach can be integrated into a learning model. The components of the STEAM approach can be integrated with the Project Based Learning model (Dewa et al., 2022).

Project-based Learning (PjBL) is one of the 21st-century learning models oriented towards problems encountered by students and how they solve them with a project (Condliffe et al., 2017).

The use of the STEAM approach, together with the PjBL model, is synchronized by presenting projects to students during the learning process as a real step in dealing with problems (Cook & Bush, 2018). The flow of project-based learning, which begins with discovering initial problems, creating project designs, compiling project flows, and presenting them, can support students' abilities in improving their understanding of the material. Therefore, the integration of STEAM based on PjBL is very suitable and follows the concept of numeracy literacy because it supports students in overcoming and analyzing problems encountered in everyday life, especially mathematical problems (Lu et al., 2022).

Several previous studies on using STEAM-PjBL teaching materials to facilitate literacy have been conducted (Purniawan et al., 2022) (Dwi et al., 2021). However, in previous research conducted by (Purniawan et al., 2022), the module created only used the STEM approach without the concept of art, and there was only one discussion of the material. Moreover, the research conducted by (Dwi et al., 2021) focused on improving science literacy skills only. Meanwhile, the module developed in this study presents several materials available for high-grade students, namely grades IV, V, and VI.

The materials include recognizing spatial shapes and their properties, factors and multiples, flat shapes, and units of time, measuring the volume of spatial shapes, and presenting and processing data. The

material is associated with each element of STEAM accompanied by a project. The selection of materials is based on the scope of numeracy literacy in mathematics material. Numeracy literacy consists of numbers, geometry and measurement, data processing, operations, and calculations (TIM GLN Kemendikbud, 2017). The importance of procuring the development of a module using the STEAM approach based on PjBL can facilitate the implementation of the Minimum Competency Assessment (AKM) process for numeracy literacy to improve students' numeracy literacy skills more effectively.

Based on the background of the problem, the objectives of this study are: (1) to develop STEAM-PjBL module for high-grade students, (2) to assess the feasibility of STEAM-PjBL module for high-grade students, (3) to determine the effectiveness of STEAM-PjBL module for high-grade students.

II. METHOD

The research method used was research and development. In general, development research is a series of procedures for developing new products or improving products made until the product can be accounted for its feasibility (Hakky et al., 2018).

The model adopted was Borg and Gall, which adopted seven of the ten existing steps. The research was conducted in SDN Pulo 01, Jembatan Selatan Street, Pulo Village, Kebayoran Baru District, South Jakarta.

The field trial to test effectiveness was only conducted on fourth-grade students due to time limitation. The fourth-grade students involved were three in the one-to-one trial, 10 in the small group trial, and 26 in the field trial. In addition, this study was conducted specifically on fourth-grade students as subjects because fourth-grade students are generally between 9 and 10 years old,they begin to understand more complex concepts such as cause and effect, classification, and simple logic (Rahman et al., 2025). This age range aligns with Piaget's theory of cognitive development, which suggests that fourth-grade students are transitioning toward more concrete thinking (Marinda, 2020).

Data collection instruments included interviews, questionnaires, and tests. The interview instrument analyzed the initial needs of students as a guideline for developing products. Furthermore, the questionnaire was given to expert validators, including media, material, and language experts.

Table 1.
Quistionnaire Instrument Grid for Media Expert Validation

No	Aspect	Statement Number
1	Module Size	1, 2
2	Module Skin Section	3, 4, 5, 6
3	Module Skin Graphics Section	7, 8, 9
4	Communicative	10
5	Module Content	11, 12, 13, 14, 15, 16, 17, 18, 19

Source: (Ristekdikti, 2017)

Table 2.
Quistionnaire Instrument Grid for Material Expert Validation

No	Aspect	Statement Number
1	Self Instruction	1, 2, 3, 4, 5, 6, 7
2	Self Contained	8, 9
3	Stand Alone	10, 11
4	Adaptive	12, 13
5	User Friendly	14

Source: (Daryanto & Dwicahyono, 2014)

p-ISSN: 2086-4280
e-ISSN: 2527-8827

Table 3.
Quistionnaire Instrument Grid for Language Expert Validation

No	Aspect	Statement Number
1	Suitability Language Standard	1, 2, 3, 4, 5
2	Communicative	6, 7, 8, 9, 10

Source: (Ristekdikti, 2017)

The questionnaire was submitted to the expert validators to assess the teaching materials that had been developed, and a different number of questionnaire statements were used for each expert validator. The expert validation questionnaire grid is presented in Table 1, Table 2, and Table 3.

Table 4.
Student Response Questionnaire

No	Aspect	Statement Number
1	Self Instruction	1, 2
2	Self Contained	3, 4, 5, 6, 7
3	Stand Alone	8, 9, 10, 11, 12, 13, 14, 15, 16
4	Adaptive	17
5	User Friendly	18

Source: (Daryanto & Dwicahyono, 2014)

Student response questionnaire was given during one-to-one and small group testing to assess the teaching materials they had used in learning. The outline of the student response questionnaire is presented in Table 4.

The test instruments used were pretests and posttests, each of which had been validated for effectiveness by experts. Pretest and posttest scores were assessed using paired sample t-tests, with a prior normality test. An N-Gain test was then used to determine the effectiveness of the instructional module. Data analysis techniques included both quantitative and qualitative.

Quantitative data analysis determines the feasibility and effectiveness of the product being developed. In contrast, qualitative analysis describes data through expert validators' suggestions, comments, or notes (Rayanto & Sugianti, 2020).

A feasibility test was conducted on experts and students to determine the advantages and disadvantages of the product being developed. The questionnaire instrument used a Likert scale with agreement on the statements starting from (5) strongly agree, (4) agree, (3) quite agree, (2) disagree, (1) strongly disagree.

The following percentage formula was used to calculate the results of the questionnaire:

$$P = \frac{(Maximum\ score)}{Total\ Score}\ x\ 100\%$$

The calculated expert's validation questionnaire data and student responses were then adjusted to the results with the feasibility criteria values, as in Table 5. The STEAM-PjBL module product that is developed is said to be feasible if it meets the "Feasible" criteria.

Table 5.
Feasible Criteria

Percentage	Criteria
81% - 100%	Very Feasible
61% - 80%	Feasible
41% - 60%	Quite Feasible
21% - 40%	Not Feasible
0% - 20%	Very Unfeasible

III. RESULT AND DISCUSSION

A. Result

The development results are STEAM modules based on Project-Based Learning (PjBL) to improve the numeracy literacy of high-grade students, carried out by researchers through the development stages of the Borg and Gall model.

1. Research and Information Collecting Stage

Initial data was collected from a needs interview with a grade IV teacher in SDN Pulo 01. The interview results included the still low implementation and ability of numeracy literacy of students in the school. It is mainly due to the lack of numeracy literacy teaching materials. Educators only use textbooks from the school, and there are no additional teaching materials or modules. The low numeracy literacy of students is also due to the lack of educators who implement fun mathematics learning close to their daily lives.

Therefore, an approach is needed so students are more active in learning, especially with real projects. It aims to make it easier for them to understand the concept of numeracy literacy because they are directly involved more deeply during the learning process.

The approach that can be collaborated with project-based learning is STEAM. In addition, the STEAM approach based on PjBL is closely related to everyday life. The mathematical material, the concept of numeracy literacy, can also be linked to STEAM elements and realized through projects. It is the basis for applying the STEAM approach based on PjBL in the developed module.

2. Planning Stage

Based on the data obtained in the initial steps, a product development plan was made that included creating the module to improve the numeracy literacy of high-grade students. Furthermore, the researchers also determined that the target users of the module were students in grades IV, V, and VI. The product content components were also determined, including a description of the title as the front page or cover of the module, developer profile, instructions for using the module for students, core competencies and indicators of learning achievement because the module was created using the Kurikulum Merdeka. The material's content domain in the developed STEAM-PjBL module contains a discussion of each interrelated STEAM element. It is accompanied by steps to create a project because the module is based on PjBL. The module is also equipped with an evaluation grid, evaluation, and discussion so that students can use it to measure their abilities when using the module when studying independently. The end of the module contains a glossary and bibliography. At this planning stage, the researchers also created a storyboard for the module product that will be developed. Then, the researchers also planned a STEAM project included in the module by adjusting the material to the basic concept of numeracy literacy in the form of measurement and shape (geometry), algebra, number and operation sense (arithmetic), and data processing (TIM GLN Kemendikbud, 2017).

3. Develop Preliminary Form of Product Stage

After planning, the researchers realized the development of the initial design of the STEAM- Project Based Learning module product through the Canva application. At this stage, the developed module product is equipped with supporting images, animations, and illustrations that are adjusted to the material and provide

p-ISSN: 2086-4280
e-ISSN: 2527-8827

background images to make it more attractive to students.

The content of the developed module is adjusted according to the planning stage.

4. Preliminary Field Testing Stage

The developed STEAM module product based on PjBL is then validated by media, material, and language experts to determine its feasibility. The media expert validator is a lecturer competent in the media field, the material expert validator is a thematic learning lecturer, and the language expert validator is a lecturer in Indonesian language education. The three expert validators provide assessments by completing questionnaires and providing comments and input. The researchers revised the module product based on the comments and input of the experts in Table 6.

Table 6.
Revision of STEAM-PjBL Module Products from Experts

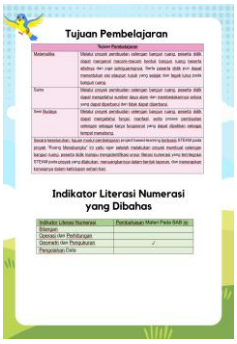
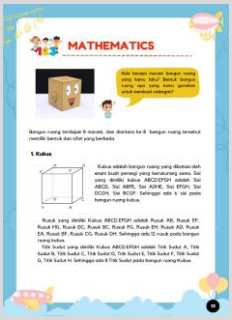
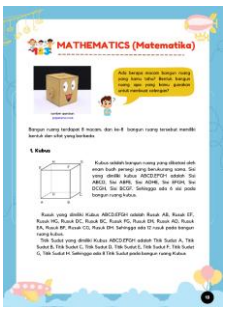
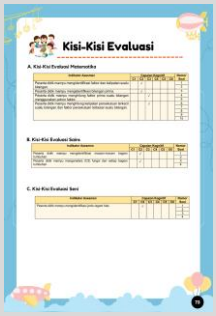
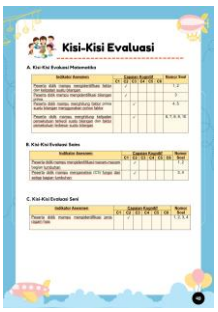
Before Revision	After Revision
	
Adding the table indicator of numeracy literacy and adjusted to discussion material based on media expert suggestion.	
	
Previously the researches did not add image resources for each image been used, so researches adding image sources under each image presented based on media.	
	
Previously there is no Indonesian translate of each foreign element of STEAM, so researchers completing the Indonesian meaning of each foreign element of STEAM in each topic discussion title based on language expert	
	
Changing the presentation position of the question number on the evaluation grid to the side so as not to be confusing.	

Table 7 shows the results of the questionnaire feasibility assessment from expert validators on the module product developed based on several aspects.

First, the scores obtained from each expert validator were calculated, and the overall percentage was calculated to measure the product's feasibility. The results obtained were 90%.

Table 7.
Results Vallue of The Expert Feasibility Validation

Media Expert (%)	Material Expert (%)	Language Expert (%)
98,5	96	76

Based on Table 7. The assessment of the module product developed by researchers from media experts is 98.5%, 96% from material experts, and 76% from language experts. So, it can be concluded that the feasibility of the STEAM-PjBL module product to improve the numeracy literacy of high-grade students is "very feasible" to be implemented because the average results obtained for the three values are 90%.

5. Desain Main Product Revision Stage

After three expert validators tested the module product, the researchers made revisions to the product being developed. The revision of the STEAM-PjBL module product was based on expert comments and input, as presented in Table 6.

6. Main Field Testing Stage

Based on expert comments and input, the revised module product was trialled on grade IV students of SDN Pulo 01. The trial was conducted on a one-to-one scale, with the STEAM-PjBL module product given to respondents to view and study. After the students finished using it, the researchers gave a response questionnaire sheet as a form of assessment and response to measure the feasibility of the developed module.

Furthermore, the small group trial was also carried out in the same way by giving the STEAM Project Based Learning module product to be viewed and studied by students. After the small group scale respondents finished using the module, the researchers gave a response questionnaire sheet to obtain their assessment and response to the developed module product.

Table 8.
One to One and Small Group Test Feasibility Results

One to One (%)	Small Group (%)
86	90

The feasibility test of the STEAM Project Based Learning module was calculated one-to-one and yielded 86% and 90% in small groups. Thus, the PjBL-based STEAM module product falls into the "Very Feasible" category for use or implementation in the next stage.

From Table 2, the practicality of the educational game being developed, researchers have a minimum target of getting a percentage of 68% or on practical criteria.

Field trials were conducted after the feasibility was obtained in one-to-one and small-group trials. In the field trial, researchers first gave ten pre-test questions. Afterwards, researchers divided students into three small groups to create STEAM projects in the module.

The project chosen for this study was creating a number tree on the material of factors and multiples.

Students made number trees using cardboard, scissors, glue, origami, and pens. The researchers gave each group a question to find a factor tree with different numbers.

The researchers observed the students' performance when doing the project

p-ISSN: 2086-4280
e-ISSN: 2527-8827

activities and found one group still wrong in determining the predetermined number of factors. The researcher gave directions to the group to evaluate the wrong multiplication results based on the factors they had written. The error found was that they wrote the wrong multiplication of the numbers that became the predetermined number factors.

Furthermore, to expand students' knowledge of the project being worked on, the researchers provide a STEAM Project Based Learning module to read. It was done so that they could conclude the material that had been read while presenting the results of their group projects in front of the class and providing feedback and appreciation between groups. The final activity in this field trial was that students were given ten post-test questions to measure their numeracy literacy after studying and working on projects from the STEAM Project Based Learning module product developed by the researchers. The pre-test and post-test results were used to determine whether the STEAM Project Based Learning module product effectively improves the numeracy literacy of high-grade students.

The data obtained from the pre-test and post-test results of the students were tested for normality first as a prerequisite for conducting the paired sample t-test. The results of the pre-test and post-test can be seen in Table 9.

Table 9.
Pre-test and Post Test Results

Test Type	Number of Students	Mean	N-Gain	Standard Deviation
Pre	26	67.23	0.61	7.98
Post	26	87.23		7.38

Based on the data from the students' pre-test and post-test results, the average learning outcomes before the implementation of the STEAM Project Based Learning module were 67.23 with a standard deviation of 7.98. The average obtained after implementing the STEAM module based on project-based learning was 87.23, with a standard deviation of 7.38. The average N-Gain test for the data obtained was 0.61, which is considered moderate. From these results, the pre-test and post-test data were then tested for normality using the Shapiro-Wilk formula. The prerequisite test was carried out before calculating the paired sample t-test.

Table 10.
Pre-test and Post Test Results

Test Type	T3	P values	t-test
Pre	0.98 (normal)	0.965	P <. 001
Post	0.97 (normal)	0.965	

Based on table 10, the pre-test and post-test analysis of data normality with the Shapiro-Wilk formula obtains a significance level of 0.98 for the pre-test value and 0.97 for the post-test value.

Both values are > a = 0.05, so H0 is accepted. It means the data is normally distributed. After the prerequisite test was carried out, the pre-test and post-test data were analyzed using the paired sample t-test. The paired sample t-test was used to determine whether there was a difference in the results in a better connotation after the pre-test and post-test (Emzir, 2014).

In the paired sample t-test, a significance value of p < .001 was obtained,

so H0 was rejected. These data show a significant difference between before and after using the STEAM Project Based Learning module, so it can be stated that the STEAM-PjBL module effectively improves the numeracy literacy of high-grade students.

7. Operational Product Revision Stage

At this stage, the researchers revised the module product based on comments obtained from one of the respondents in the small group trial. The comments obtained in the small group test were that several sentences in the module's evaluation were difficult to understand. After that, no final revisions were made.

B. Discussion

The final result of the developed product is a STEAM module based on Project Based Learning. The research and development of this teaching material product is declared feasible and effective. It is feasible because the product developed is based on a needs analysis, the need for teaching materials that use an approach with real projects. It is in accordance with the STEAM approach- Project Based Learning, which can provide new content accompanied by real projects close to students' daily lives. The STEAM approach produces several advantages, such as fostering empathy, actively helping students integrate techniques into the design process, and making it easier for students to understand mathematical concepts through the relationship between STEAM elements realized with projects (Sukmana, 2017).

During the development phase, researchers created module products based on the storyboard designs they had created. Specifically, they also assigned titles to each STEAM project within the module. Each STEAM project within the module was integrated with numeracy literacy indicators tailored to the presentation of the material at each level. Several projects within the module were included. The first, titled "My Savings Room," involved creating a simple piggy bank using recycled cardboard. This project represented the mathematics topic "Space and Symmetry" and the science topic "Recyclable Resources." The second project, titled "Number Tree," involved students creating a tree structure using origami, from roots to trunk, leaves, and fruit.

These projects were then numbered to represent the mathematics topic "Number Factorization and Multiples" and to represent the science topic "Plant Parts and Their Functions." The third project, titled "My Kite Creation," featured the mathematics topic "Flat Shapes" and represented the science topic "Gravity," as it involved creating a kite. The fourth project, titled "Diagram Board," involved students creating a diagram board using origami and recycled Styrofoam to calculate data and percentages related to the science topic "Animal and Plant Conservation." Students learned about calculating the percentage of animal extinctions in Indonesia.

The materials presented in the module specifically represent each indicator of numeracy literacy. The "Number Tree" project is particularly relevant because it teaches students about numbers, operations and calculations, geometry, and

measurement, all of which are used to create circles that represent the fruit on the tree. Students also learn about data processing, as the "Number Factorization" lesson simplifies a number to find its factors and multiples.

In the development stage, researchers create module products based on the storyboard design that has been made. In doing the module, researchers designed it as attractively as possible with a variety of colour combinations used along with supporting images of materials and animations. The choice of colour in teaching material must be considered because it can help students be more interested and focused on the information presented (Chang et al., 2018). After the developed module is complete, experts validate the next stage. The validation results meet the feasibility criteria. A product must meet the feasibility criteria for application (Akhmadan, 2017). Experts in media, material, and language validated the results.

The results of expert assessments of the STEAM Project Based Learning module product developed by researchers obtained an average total of 90%, so the product was declared "very feasible" to use. The feasibility of a product shows the quality of the relationship between what is measured and the learning objectives (Emzir, 2014).

After the STEAM Project Based Learning module was declared valid, a one-to-one trial was conducted, followed by a small group trial, and the results were "very feasible". Based on the assessment results obtained, it can be interpreted that students are enthusiastic about using the STEAM- Project Based Learning module developed by researchers and are interested in its contents. It is in line with the results of research (Ayuningsih et al., 2022), which states that modules that use STEAM Project Based Learning in learning can attract students' interest in learning.

A product is declared feasible based on a trial; thus, the module can be used properly because it facilitates learning (Akhmadan, 2017).

Furthermore, after the STEAM Project Based Learning module was implemented in a field trial of 26 grade IV students, they were first given a pre-test and divided into three small groups to make STEAM projects. Students were very enthusiastic when making projects by designing their group project results differently, uniquely, and creatively. Project-based learning can optimize students' creativity, and they can explore their learning styles by implementing concrete projects (Amamou & Cheniti-Belcadhi, 2018). When making projects, students use simple tools and materials that help with their process, such as scissors, cardboard, glue, and origami paper. Children's equipment ranges from simple forms to technology that can help them solve problems but must still be adjusted to their developmental age (Henriksen et al., 2017).

The field test activity ended with the provision of a post-test of 10 questions to measure the numeracy literacy of students before and after learning using the STEAM Project Based Learning module developed by the researchers. The average pre-test score was 67.23, with a significance level of

0.98 in the normality test, and the average post-test score was 87.23, with a significance level of 0.97, which means that the data is normally distributed.

Then, the results of the scores were continued to be tested using a paired sample t-test, and a significance of 0.000 <a = 0.05 was obtained so that the decision H0 was rejected. There is a significant difference between before and after using the STEAM Project Based Learning module, so the product of the developed module is effective in improving the numeracy literacy of high-grade students. In line with research (Hadiyanti et al., 2021), using teaching materials based on STEAM-PjBL can improve numeracy literacy skills.

This study has a novelty compared to previous studies where several materials are discussed in the module. The focus of the discussion of mathematical materials in the module is also adjusted to the material that is the basic concept of numeracy literacy, including measurement and shape (geometry), algebra, number and operation sense (arithmetic), data processing (Kemendikbud, 2017). The developed module product also connects each mathematical material with each STEAM element, accompanied by a project. It makes it easy for students to understand numeracy literacy because it is made close to the problems they encounter in everyday life (Sari, 2022).

The final product results of the development of STEAM Project Based Learning module teaching materials were declared feasible and effective in improving the numeracy literacy of upper elementary school students especially for fourth-grade students, as seen in Figure 1.

Figure 1. Final Product Result.

The developed module has advantages such as displays and animations that attract students' interest, accompanied by various colour combinations.

The material provided is related to the basic concept of numeracy literacy, helping students actively solve real-world mathematical problems by applying numeracy literacy skills. Numeracy literacy skills can help students solve mathematical problems encountered in graphs, tables, diagrams, and so on (Rohim, 2021). It aligns with the advantages of the STEAM approach based on PjBL, which can improve students' linguistic and mathematical competencies, especially calculating mathematical problem-solving (Duo-Terron et al., 2022).

In addition, STEAM learning helps students see the world from a new perspective by applying mathematical elements linked to science, technology, engineering, and art (Lu et al., 2022). Integrating STEAM with PjBL improves students' ability to explore knowledge from various sources to find information.

Therefore, STEAM-PjBL learning is suitable for improving numeracy literacy as a skill needed in the 21st century.

IV. CONCLUSION

Based on validation results with media, materials, and language experts, it can be concluded that the STEAM Instructional Module based on Project-Based Learning (PjBL) are feasible for use in the learning process. Furthermore, It received positive feedback during one-to-one and small group trials with students.

This is evident in the module's alignment with the basic concepts of numeracy literacy and existing learning outcomes, clear learning objectives, engaging animations and images, and clear and easy-to-read Indonesian language rules. Based on the field trial results, the STEAM-based PjBL Instructional Module effectively improved the numeracy literacy of fourth-grade elementary school students, who served as the research subjects, as they represented higher-grade students due to time constraints. Educators can contribute to this module as a tool for students to learn independently. Due to time constraints, future researchers are recommended to pilot the STEAM-based PjBL Instructional Module with fifth- and sixth-grade students.

REFERENCES

Akhmadan, W. (2017). *Pengembangan Bahan Ajar Materi Garis dan Sudut Menggunakan Macromedia Flash Dan Moodle Kelas VII Sekolah Menengah Pertama*.

Amamou, S., & Cheniti-Belcadhi, L. (2018). Tutoring in Project-Based Learning. *Procedia Computer Science*, *126*, 176–185. https://doi.org/10.1016/j.procS.2018.07.221

Apriliana, M. R., Ridwan, A., Hadinugrahaningsih, T., & Rahmawati, Y. (2018). Pengembangan Soft Skills Peserta Didik melalui Integrasi Pendekatan Science, Technology, Engineering, Arts, and Mathematics (STEAM) dalam Pembelajaran Asam Basa. *JRPK: Jurnal Riset Pendidikan Kimia*, *8*(2), 42–51. https://doi.org/10.21009/jrpk.082.05

Ayuningsih, F., Sutama, S., & Suyatmini, S. (2022). Pengembangan Modul Ajar Matematika Materi Kuantor Berbasis Steam Project Based Learning. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, *11*(4), 3285. https://doi.org/10.24127/ajpm.v11i4.6021

Chang, B., Xu, R., Watt, T., Chang, B., Xu, R., Watt, T., & Watt, T. R. (2018). The Impact of Colors on Learning. In *Canada*, *10*.

Condliffe, B., Quint, J., Visher, M. G., Bangser, M. R., Drohojowska, S., Saco, L., & Nelson, E. (2017). *Project-Based Learning A Literature Review Working Paper*. www.mdrc.org.

Conradty, C., Sotiriou, S. A., & Bogner, F. X. (2020). How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation. *Education Sciences*, *10*(3), 1–15. https://doi.org/10.3390/educsci10030070

Cook, K. L., & Bush, S. B. (2018). Design Thinking in Integrated STEAM Learnin g Surveying the Landscape and Exploring Exemplars in Elementary Grades. *School Science and Mathematics, 18*(3), 93–103.

Daryanto, & Dwicahyono, A. (2014). *Pengembangan Perangkat Pembelajaran (Silabus, RPP, PHB, Bahan Ajar)*. Gava Media.

Deda, Y. N., Disnawati, H., & Daniel, O. (2023). How Important of Students' Literacy and Numeracy Skills in Facing 21st-Century Challenges: A Systematic Literature Review. *Indonesian Journal of Educational Research and Review*, *6*(3), 563–572. https://doi.org/10.23887/ijerr.v6i3.62206

Dew, O., Made, A., Priantini, M. O., Suarni, N. K., Ketut, I., & Adnyana[3], S. (2022). Analisis Kurikulum Merdeka Dan Platform Merdeka Belajar Untuk Mewujudkan Pendidikan Yang Berkualitas. *Jurnal Penjaminan Mutu*, *8*(2), 238–244.

Duo-Terron, P., Hinojo-Lucena, F. J., Moreno-Guerrero, A. J., & López-Núñez, J. A. (2022). STEAM in Primary Education. Impact on Linguistic and Mathematical Competences in a Disadvantaged Context. *Frontiers in Education*, *7*. https://doi.org/10.3389/feduc.2022.792656

Dwi, R., Maghfira Izzania, S., Winarni, E. W., & Koto, I. (2021). Pengembangan Bahan Ajar Berbasis PjBL Terintegrasi STEAM Untuk Memfasilitasi Kemampuan Literasi Sains Siswa Sekolah Dasar. *Pendidikan Dasar*, *4*(2), 2654–2870.

Emzir. (2014). *Metodologi Penelitian Pendidikan Kuantitatif & Kualitatif* (9th ed.). PT. Raja Grafindo Persada.

Fernandez, R. C., & Romero, M. C. (2020). Robotics and STEAM Projects: Development of Creativity in a Primary School Classroom. *PIXEL BIT*, *58*, 51–69.

Hadiyanti, N. F. D., Hobri, Prihandoko, A. C., Susanto, Murtikusuma, R. P., Khasanah, N., & Maharani, P. (2021). Development of Mathematics E-Module with STEM-Collaborative Project Based Learning to Improve Mathematical Literacy Ability of Vocational High School Students. *Journal of Physics: Conference Series*, *1839*(1). https://doi.org/10.1088/1742-6596/1839/1/012031

Hakky, M. K., Hardi Wirasasmita, R., & Uska, M. Z. (2018). *Pengembangan Media Pembelajaran Berbasis Android Untuk Siswa Kelas X Pada Mata Pelajaran Sistem Operasi* Edumatic: Jurnal Pendidikan Informatika, 2(1), 24. https://doi.org/10.29408/edumatic.v2i1.868

Henriksen, D., Richardson, C., & Mehta, R. (2017). Design Thinking: A Creative Approach to Educational Problems of Practice. *Thinking Skills and Creativity*, *26*(7).

Katz-Buonincontro, J. (2018). Gathering STE(A)M: Policy, Curricular, and Programmatic Developments in Arts-Based Science, Technology, Engineering, and Mathematics

Education Introduction to the Special Issue of Arts Education Policy Review: STEAM Focus. *Arts Education Policy Review*, *119*(2), 73–76.

Kemendikbud. (2017). *Materi Pendukung Literasi Numerasi*. TIM GLN Kemendikbud.

Lu, S. Y., Lo, C. C., & Syu, J. Y. (2022). Project-Based Learning Oriented STEAM: The Case of Micro–Bit Paper-Cutting Lamp. *International Journal of Technology and Design Education*, *32*(5), 2553–2575. https://doi.org/10.1007/s10798-021-09714-1

Marinda, L. (2020). Teori Perkembangan Kognitif Jean Piaget dan Problematikanya Pada Anak Usia Sekolah Dasar. *Jurnal Kajian Perempuan Dan Keislaman, 13*(1), 116–152.

Mauza, M. S. P., Sofiyana, M. S., & Rosyida, D. A. (2022). Pengaruh Model Pembelajaran STEAM Terintegrasi Knisley Terhadap Literasi Numerasi Dan Hasil Belajar Siswa Kelas IV Sekolah Dasar. *Jurnal Handayani*, *13*(2), 78–85.

Prihandoko, L. A. (2021). *The Interplay between Digital Competencies and Information Literacy in Academic Writing Online Class during COVID-19 Pandemic (PLS-SEM Approach)*. *Eralingua: Jurnal Pendidikan Bahasa Asing dan Sastra, 5*(1). https://doi.org/10.26858/eralingua.v5i1.18843

Purniawan, P., Hidayah, I., & Sukestiyarno, Y. L. (2022). The STEM-based Mathematics Module Development to Improve Numerical Literacy and Learning Self-Directness of Fifth Graders. In *Journal of Primary Education, 11*(2).

Rakhmawati, Y., & Mustadi, A. (2022). The Circumstances of Literacy Numeracy Skill: Between Notion and Fact From Elementary School Students. *Jurnal Prima Edukasia*, *10*(1), 9–18. https://doi.org/10.21831/jpe.v10i1.36427

Rayanto, Y. H., & Sugianti. (2020). *Penelitian Pengembangan Model ADDIE dan R2D2: Teori & praktek.* (T. Rokhmawan & M. Z. Arifin, Eds.; 1st ed.). Lembaga Akademik & Research Institute.

Rika, B., Febrilia, A., & Juliangkary, E. (2019). Peningkatan Kemampuan Guru Dalam Mengembangkan Rancangan Permasalahan Matematika Ditinjau Dari Level Kemampuan Berpikir Siswa. *Jurnal Pendidikan Matematika*, *4*(1), 49–68.

Ristekdikti. (2017). *Standar Buku dan Modul Ajar*.

Rohim, D. C. (2021). Konsep Asesmen Kompetensi Minimum untuk Meningkatkan Kemampuan Literasi Numerasi Siswa Sekolah Dasar. *Jurnal VARIDIKA*, *33*(1), 54–62. https://doi.org/10.23917/varidika.v33i1.14993

Rahman, S. Harahap, F. K. S., Parapat, K. M., Nurhafizah, Ramadhani, R., & Lubis, R. (2025). Implikasi Perkembangan Pembelajaran Peserta Didik Kelas 4 Sekolah Dasar. *Journal of Contemporary Research, 2*(1), 282–

291. https://doi.org/10.61253/1sqxas13

Salma, A., & Mudzanatun. (2019). Analisis Gerakan Literasi Sekolah Terhadap Minat Baca Siswa Siswa Sekolah Dasar. *Mimbar PGSD Undiksha*, *7*(2).

Sari, P. K. (2021). *STEAM Modul Pembelajaran Berbasis Project Based Learning* (A. U. P. Santi, Ed.; 1st ed.). UM Jakarta Press.

Sari, P. K. (2022). Pengembangan E-Modul Berbasis STEAM untuk Meningkatkan Kemampuan Berpikir Tingkat Tinggi pada Pembelajaran Tematik di Sekolah Dasar. *JPSI*, *10*(3), 509–526. https://doi.org/10.24815/jpsi.v6i3.24789

Sari, R. H. N. (2016). Literasi Matematika: Apa, Mengapa, dan Bagaimana. *In Prosiding Seminar Nasional Matematika dan Pendidikan Matematika, UNY, 713-720*

Siantajani, Y. (2020). *Konsep dan Praktek STE(A)M di PAUD*. Sarang Seratus Aksara.

Sukmana, R. W. (2017). Pendekatan Science, Technology, Engineering and Mathematics (STEM) Sebagai Alternatif Dalam Mengembangkan Minat Belajar Peserta Didik Sekolah Dasar. *Jurnal Ilmiah Pendidikan Dasar*, *2*(2), 191–199.

Suprapto, N., Sunarti, T., Suliyanah, Wulandari, D., Hidayaatullaah, H. N., Adam, A. S., & Mubarok, H. (2020). A Systematic Review of Photovoice as Participatory Action Research Strategies. *International Journal of Evaluation and Research in Education*, *9*(3), 675–683. https://doi.org/10.11591/ijere.v9i3.20581

Tan, W. L., Samsudin, M. A., Ismail, M. E., Ahmad, N. J., & Talib, C. A. (2021). Exploring the Effectiveness of STEAM Integrated Approach via Scratch on Computational Thinking. *Eurasia Journal of Mathematics, Science and Technology Education*, *17*(12). https://doi.org/10.29333/ejmste/11403

TIM GLN Kemendikbud. (2017). *Materi Pendukung Literasi Numerasi*.

Tjiptiany, E. N., As'ari, A. R., & Muksar, M. (2016). *Pengembangan Modul Pembelajaran Matematika dengan Pendekatan Inkuiri untuk Membantu Siswa SMA Kelas X dalam Memahami Materi Peluang*. Jurnal Pendidikan: Teori Penelitian, dan Pengembangan, 1(10), 1938-1942. https://doi.org/10.17977/jp.v1i10.6973

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