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Development of Integrated Teaching Modules for Growth Mindset and Deep Learning on Straight Line Equation Material Oriented to Numeracy Ability of Junior High School Students

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ABSTRACT

This research is motivated by junior high school students' suboptimal numeracy ability in understanding information, building mathematical models, connecting representations, applying concepts, reasoning, and examining and reflecting on results in straight-line equation materials. This research aims to develop an integrated teaching module, Growth Mindset and Deep Learning, that is oriented to the numeracy skills of junior high school students. The methods used are research and development with a 4D model, which includes define, design, develop, and disseminate. The define stage identifies teaching material needs that are contextual, adaptive, and student-centered. The data analysis techniques used in this study were tailored to the type of data and the research phases. During the define phase, the data were analyzed qualitatively using ATLAS.ti. Meanwhile, in the develop stage, the data were analyzed quantitatively, including a chi-square goodness-of-fit test for product validation, an analysis of the proportion of student and teacher responses to measure practicality, and a one-sample comparative test for target proportion criteria in measuring the product's effectiveness. The development phase showed that the module met the validity criteria across three validators: media, pedagogy, and content. The module also demonstrated its practicality by receiving positive feedback from 76% of 30 students and 100% of observers regarding the implementation of the learning process. The effectiveness test showed that 28 out of 30 students (93.33%) fell into numeracy ability category 1, indicating a significant relationship between the KKTP criteria and students' numeracy abilities. The dissemination stage was carried out by publishing modules on the PMT UNWIR page. Overall, the modules developed can serve as alternative teaching materials to support contextual, active, reflective, and meaningful mathematics learning, as well as strengthen students' numeracy skills and growth mindset.

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Introduction

Numeracy challenges at the junior high school level indicate that students still need learning experiences that connect mathematical concepts to contextual situations, representations, and reasoning. Findings from a study on the numeracy skills of students in SMP and MTs show that numeracy must be understood in conjunction with dispositional factors including a growth mindset as both are related to how students' approach and solve mathematical problems (Wijaya, 2023). This issue becomes increasingly relevant as learning requires students to use mathematics to understand relationships between variables, interpret graphs, and make decisions based on quantitative information. Research on mathematical literacy in Indonesia also indicates that the 2022 PISA results confirm the continued challenges in students' mathematical abilities, underscoring the need to integrate literacy and numeracy activities into mathematics instruction (Maulina et al., 2024).

Problems with mathematical proficiency in understanding and using information in contextual situations remain a challenge for students in Indonesia. The OECD (2023) reported that Indonesia's mathematics score on the 2022 PISA was 366, and only 18% of students reached Level 2 or higher, while the OECD average was 69%. This situation indicates that many Indonesian students still struggle with the basic mathematical skills needed to recognize and represent simple situations mathematically. The OECD (2026) also indicates that in PISA 2025, Indonesia's math score was 364, with only 17% of students reaching Level 2 or higher, while the OECD average was 463 and 65% of OECD students reached that level.

Junior high school students' numeracy skills are the ability to use mathematical concepts, procedures, facts, and reasoning to understand situations, make decisions, and solve contextual problems. Getenet (2022) this view emphasizes that numeracy involves not only mathematical skills but also logical thinking and reasoning strategies in daily life. This ability is increasingly important at the junior high school level because students begin learning abstract concepts such as algebra, graphs, comparisons, data, and geometry, which require interpreting quantitative information appropriately. Setiyani et al. (2024) found that grade VIII students still struggle to understand text-based or context-based numeracy problems, identify information, and determine solution strategies, while Bolstad (2023) highlights the importance of connecting mathematics learning to real-life contexts so mathematical literacy becomes more meaningful. Therefore, strengthening numeracy requires contextual, challenging, and reflective learning so students can provide answers, explain reasons, evaluate information, and apply mathematics meaningfully.

Numeracy skills at the junior high school level are not only related to mastery of mathematical procedures but also to the ability to use mathematical knowledge to understand information, connect various representations, select strategies, and interpret results in real-life contexts. Setiyani et al. (2024) demonstrated that junior high school students still struggle with solving context-based numeracy problems, particularly in understanding information and determining appropriate solution strategies. Therefore, mathematics instruction must provide experiences that enable students to connect concepts, representations, and contexts so that mathematics does not stop at the ability to obtain answers. Astuti et al. (2024) emphasize the importance of contextual numeracy learning so that students can connect school mathematics with their social and cultural experiences in their environment.

In the Linear Equations unit, numeracy skills can be directly assessed through students' ability to understand the relationship between two variables, represent that relationship in tables and graphs, determine the rate of change using the slope, and construct and interpret

mathematical models of real-world situations. The development of e-modules on the topic of Linear Equations demonstrates that instructional materials can be designed to help students understand the subject matter through structured digital activities, however, the focus remains primarily on validity, practicality, and understanding of the material (Siti Kholisah et al., 2024). Thus, the "Linear Equations" topic is not only relevant for mastering algebraic procedures but also provides a strong context for developing numeracy processes namely, understanding, applying, and reasoning. Research on the development of an electronic module based on GeoGebra Book on the same topic also highlights opportunities to use the module to enhance the learning experience, although its primary focus is on digital literacy and it has not yet specifically integrated a Growth Mindset or Deep Learning (Jatmiko & Lestari, 2025).

Junior high school students' numeracy ability is reflected in their ability to understand quantitative information, connect mathematical concepts to context, choose solution strategies, and interpret results logically. Astuti et al. (2024) emphasized that numeracy should be developed through contextual learning so students can relate school mathematics to the social and cultural experiences around them. In the Straight-Line Equation material, numeracy includes the ability to read graphs, understand relationships between variables, determine gradients, interpret cut-off points, and compile mathematical models from real situations, not just using formulas. Santos et al. (2022) show that junior high school students' number sense is related to learning characteristics and self-efficacy in mathematics, so numeracy also requires confidence, flexible thinking, and perseverance in solving non-routine problems. Therefore, numeracy learning in the Straight-Line Equation material needs to be designed contextually, gradually, and reflexively so that students can build a deeper understanding of mathematics.

In addition to the characteristics of the subject matter, the need to develop modules is also related to a learning approach that can transform mathematical activities from merely finding answers to a process of understanding meaning, applying knowledge, and reflecting on learning experiences. In Indonesian mathematics education research, Deep Learning is understood as an approach that emphasizes conscious, meaningful, and enjoyable learning, which can be realized through learning experiences that connect mathematical concepts to real-life situations (Rahayu et al., 2025). These characteristics align with the Linear Equation unit because concepts such as slope, equations, graphs, and relationships between variables can be explored through authentic problems that are relevant to students' lives. The development of Deep Learning-based mathematics teaching modules also demonstrates that this approach can be systematically incorporated into instructional materials, resulting in modules that are valid, practical, and effective in promoting cognitive learning outcomes (Anggraini et al., 2025).

Empirical evidence shows that junior high school students' numeracy skills are uneven and not optimal for solving contextual problems that require reasoning, modeling, and interpretation. Setiawan et al. (2023) found that the mathematical numeracy skills of grade VIII junior high school students have not met all indicators, especially in reasoning, formulating, solving, and interpreting daily-life problems. This suggests that some students still view mathematics as a calculation procedure rather than a tool for understanding data, making decisions, and solving real problems logically. Susanta et al. (2023) also found that problem-solving is the weakest aspect of context-based mathematics literacy tasks, even though these tasks can increase students' literacy activities. Thus, low numeracy relates not only to concept mastery but also to reasoning skills, connecting mathematics to context, and the availability of assessments that encourage reflective thinking.

A growth mindset complements deep learning because it provides students with a dispositional foundation for viewing difficulties, mistakes, and effort as part of the process of

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developing mathematical ability. Research on middle school students shows that a Growth Mindset is associated with numeracy skills and is one of the aspects that needs to be considered in mathematics instruction that requires problem-solving and reasoning (Wijaya, 2023). In instructional practice, this mindset needs to be translated into activities that provide students with opportunities to try out strategies, discuss mistakes, receive feedback, and reflectively refine their solutions. A quasi-experimental study of junior high school students also shows that Problem-Based Learning can enhance both a growth mindset in mathematics and mathematical connection skills; thus, an active and challenging learning environment can serve as a space that supports the development of a growth mindset (Nugraha & Yulianti, 2025).

The gap in junior high school students' numeracy skills is primarily caused by mathematics instruction that has not effectively connected concepts, procedures, and reasoning to real-world problems. Sadat et al. (2026) show that student characteristics, family background, the school community, the education system, and social conditions influence mathematics achievement. This gap is evident when students can solve routine problems but struggle to understand quantitative information, select strategies, and interpret results in everyday contexts. Andriani et al. (2026) emphasize that cognitive factors, self-efficacy, socioeconomic status, language, assessment practices, and teacher readiness contribute to barriers in formulating and interpreting contextual problems. These include verbal representations, tables, graphs, and algebraic symbols.

The integration of the Growth Mindset and Deep Learning in this module is based on their complementary functions: the Growth Mindset as the foundation for learning dispositions and Deep Learning as a pedagogical framework for creating conscious, meaningful, and enjoyable learning experiences. This relationship is supported by research showing a correlation between a Growth Mindset and students' numeracy skills, suggesting that belief in the potential for skill development can be a crucial component of mathematics learning (Wijaya, 2023). Through this integration, students are guided not only to understand the procedures for determining the slope or the equation of a line but also to confidently tackle non-routine problems, select strategies, connect representations, interpret results, and reflect on mistakes. The finding that a Growth Mindset is associated with literacy and numeracy in the implementation of the Merdeka Curriculum further strengthens the rationale for positioning the Growth Mindset as a principle of instructional design, rather than as an outcome variable to be measured in this study.

To address the numeracy gap among junior high school students in Straight-Line Equation material, develop a growth mindset-based teaching module integrated with deep learning so students can understand, model, and solve contextual problems. Boaler et al. (2021) show that the mathematical mindset approach can improve mathematical achievement while changing students' confidence in their learning abilities. The module should include diagnostic assessments, gradient exploration in real-world situations, problem-solving discussions, error reflection, graded exercises, contextual tasks, and formative feedback. Dong et al. (2023) emphasized that growth mindset influences mathematics achievement through intrinsic motivation, failure attribution, self-efficacy, and mathematical anxiety, so students need guidance to view mistakes as part of the learning process. Thus, growth mindset-based teaching modules integrated with deep learning are relevant for reducing the numeracy gap by strengthening cognitive, affective, and learning strategies in an integrated manner.

Integrated Deep Learning and Linear Equations

Developing a growth mindset-based teaching module integrated with deep learning on the Straight-Line Equation material is a systematic process for teaching gradients, line equations, graphs, and relationships between representations through meaningful and reflective activities. The growth mindset view holds that mathematical abilities can develop through effort, learning strategies, feedback, and intrinsic motivation, which influences how students face difficulties (Dong et al., 2023). This module includes objectives, materials, LKM, assessments, and learning steps, and it also encourages students to try, correct mistakes, explain mathematical reasoning, and believe their understanding can grow. Deep learning integration is necessary because deep learning strategies can increase engagement, mathematical achievement, and practical intelligence through activities that involve understanding, analyzing, and applying concepts, rather than just memorizing procedures (Hammadi et al., 2023). Thus, this module aims to produce teaching materials that are valid, meaningful, and adaptive, and that support the improvement of junior high school students' numeracy skills.

A review of previous research shows that the development of instructional materials on Linear Equations, Growth Mindset, and Deep Learning has progressed, but these three topics have not yet been extensively integrated into a single numeracy-oriented module design. Regarding Linear Equations, research by Siti Kholisah et al. (2024) developed an interactive Android-based e-module, while Jatmiko & Lestari (2025) developed a GeoGebra Book-based electronic module with a focus on digital literacy. In the realm of the Growth Mindset, previous research has shown that certain learning approaches can support the development of a growth mindset and mathematical abilities, but these have not yet been specifically integrated with Deep Learning in the “Linear Equations” module. Meanwhile, the study by Anggraini et al. (2025) has developed a Deep Learning-based mathematics teaching module, and the study by Rahayu et al. (2025) confirms the compatibility of Deep Learning principles with contextual mathematics learning, however, neither has specifically integrated a Growth Mindset nor directed their products toward measuring numeracy through Linear Equations material.

Studies that develop growth mindset-based teaching modules integrated with deep learning on Straight Line Equations material to measure junior high school students' numeracy based on posttest results remain limited. Bui et al. (2023) show that growth mindset interventions in mathematics learning provide more positive results when adjusted to the material and student needs. Kolar & Hodnik (2021) also found that deep learning strategies affect students' mathematical achievement and practical intelligence. Meanwhile, emphasized that mathematical literacy develops through the ability to recognize, use, and interpret mathematical knowledge in contextual problems. Therefore, this research is novel in integrating growth mindset and deep learning in the Straight-Line Equation module to support reflective, contextual learning oriented toward numeracy measurement through posttest results.

Based on this analysis, the research gap lies in the suboptimal integration of the characteristics of the “Equations of Straight Lines” material, the principles of the Growth Mindset, and the learning experiences of Deep Learning within a single instructional module explicitly focused on numeracy skills. This gap is significant because previous research has tended to focus on different aspects when developing modules, such as content understanding, digital literacy, learning outcomes, or specific mathematical skills (Jatmiko & Lestari, 2025; Siti Kholisah et al., 2024). This study therefore positions the Growth Mindset as a principle that shapes students’ responses to challenges and mistakes, while Deep Learning is used to design processes for understanding, applying, and reflecting through the context of Linear Equations.

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This approach aligns with recent research findings indicating that a Growth Mindset is associated with numeracy skills and that Deep Learning can serve as a relevant approach for creating meaningful mathematics learning experiences (Rahayu et al., 2025; Wijaya, 2023).

Conceptually, the developed module integrates the content components of Linear Equations with contextual exploration activities, tabular and graphical representations, mathematical modeling, problem-solving, reflection on errors, and feedback. The design follows the principles of Deep Learning, which emphasizes the interconnectedness of conceptual understanding, knowledge application, and reflection in meaningful learning experiences (Rahayu et al., 2025). At the same time, each activity is designed to provide space for students to experiment, refine their strategies, and view difficulties as part of their skill development, thereby ensuring that a Growth Mindset serves as a pedagogical principle guiding the learning process. Research on the Growth Mindset in mathematics learning also highlights the importance of a learning environment that provides students with opportunities to face challenges and develop the belief that mathematical ability can be developed (Nugraha & Yulianti, 2025).

Based on this description, this study aims to develop a Growth Mindset-based teaching module integrated with Deep Learning and oriented toward supporting junior high school students' numeracy skills. This study describes the process of developing the teaching module and evaluates its quality through expert evaluation. Furthermore, the study analyzes students' numeracy achievement after participating in learning with the developed module. Thus, this research produces a teaching module that supports students' understanding of Straight-Line Equations through effort, learning strategies, reflection on mistakes, and active involvement in solving contextual problems.

Method

Settings

This research uses a research and development (R&D) approach by adapting the 4D model (Four-D), which consists of define, design, develop, and disseminate stages. This model was chosen because it provides a systematic procedure, from identifying needs and designing products to testing, refining, and disseminating products assessed as feasible. The interconnection between stages allows each development decision to be based on data from the previous stage, so that the research process can be traced methodologically (Usmeldi & Amini, 2022). Applying the 4D model to develop learning tools has also been shown to produce valid, practical products and effective learning responses (Hariyono et al., 2024). Therefore, the 4D model is suitable for developing teaching modules that integrate growth mindset and deep learning on straight-line equation materials and target junior high school students' numeracy skills. The research was conducted in a junior high school (SMP) in Indramayu Regency, Indonesia, during the 2026/2027 academic year. In the define stage, interviews were conducted with three students selected purposively based on their mathematics ability categories, namely high, medium, and low ability. These interviews were intended to identify students' learning needs, difficulties, and initial characteristics related to numeracy skills in the context of straight-line equations. Subsequently, at the product trial stage, the developed teaching module was implemented in one class as the trial participants to examine its feasibility in the actual classroom setting.

Research Design

Define

The define stage aims to determine the needs and limitations of product development through an early-end analysis of student characteristics, tasks, concepts, and learning objectives. The early-end analysis identifies the learning conditions for the Straight-Line Equation, students' numeracy skills, the teaching materials used, and gaps between actual and expected conditions. The analysis of student characteristics includes initial abilities, learning difficulties, responses to errors, and problem-solving strategies. This analysis is also used to identify student learning support needs. Meanwhile, task and concept analysis is carried out by examining Learning Outcomes, learning objectives, scope of materials, learning activities, and numeracy skills that need to be developed. Data on student needs were obtained through one contextual description question on the linear relationship between travel distance and taxi fare, followed by interviews to clarify understanding of context, thinking processes, formation of mathematical models, application of gradients and line equations, interpretation of answers, and responses to difficulties. Interviews with teachers gathered information on learning planning and implementation, teaching materials, scaffolding, differentiation, assessment, feedback, growth mindset, and deep learning. Interviews with the Vice Principal for Curriculum identified curriculum policies, school support, facility availability, and opportunities for module implementation. In addition, the team reviewed curriculum documents to ensure product alignment with Learning Outcomes and school learning characteristics. All analysis results served as the basis for formulating the specifications of the curriculum modules and the Student Worksheets (LKM) developed.

Design

The design stage translates the needs analysis results into an initial product design by establishing the material structure, learning strategy, LKM format, supporting media, assessment system, and module format. The module is designed for five meetings, with an allocation of 10 × 40 minutes, and includes gradients, the form of the equation $y = mx+c$, the equation of lines through two points, graph representation, and the application of the Straight-Line Equation in contextual problems. Student-centered learning is applied through Discovery Learning, Problem-Based Learning, and Jigsaw combined with the principles of Deep Learning, namely awareness, meaning, and encouragement, as well as the experience of understanding, applying, and reflecting. Activities such as checking and correcting mistakes, trying alternative strategies, using feedback, asking for help, reflection, the Mindset Assessment Profile (MAP), diagnostic assessments, grouping by learning readiness, and tiered scaffolding support a growth mindset and diverse initial abilities. MFIs are visually designed and structured with exploration activities, contextual problems, guide questions, step-by-step assistance, resolution space, and reflection, while assessments include interactive quizzes, “Bangun Kotamu” board games, “Data Nyataku” mini projects, exit tickets, summative tests, and assessment rubrics, which produce an initial prototype of the module that is ready to be assessed at the develop stage.

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Develop

The develop stage aims to produce a teaching module that meets the criteria of validity, practicality, and effectiveness within the scope of the trial. Three validators assessed the initial prototype, consisting of a lecturer as a material expert, a lecturer as a media expert, and a teacher as a pedagogical expert. The selection of validators was adjusted to their respective areas of expertise and the type of validation conducted. The pedagogical expert was selected from among teachers because of their practical experience in the learning process, understanding of student characteristics, and familiarity with the implementation of learning in school settings. Meanwhile, lecturers were involved as material and media experts because they possess relevant academic competencies and educational qualifications in the areas being validated. This selection was intended to ensure that the validation process covered both pedagogical practicality and the academic and technical aspects of the product. The validation sheets used a Likert scale and open-ended comments covering the accuracy and breadth of the learning materials, alignment with learning objectives, quality of presentation, visual design, language use, implementation of learning activities, assessment system, and consistency in the application of Growth Mindset and Deep Learning. The validators' assessments and suggestions were used to revise the product to ensure that it met the feasibility criteria. After being declared feasible, the teaching module was subjected to a limited trial involving students from Grade VIII, conducted over one to two meetings. The students were selected purposively based on the characteristics of the target users. The trial covered sections of the module that represented the main objectives and characteristics of the product. Practicality was examined through student response questionnaires and teacher observation sheets covering ease of use, readability of instructions, visual appeal, implementation of activities, adequacy of time, and the usefulness of the product. Effectiveness was assessed based on students' posttest achievement of the numeracy learning objectives being evaluated. Thus, the results of the limited trial were used to evaluate the attainment of the assessed objectives rather than to provide causal evidence of an improvement in students' abilities.

Disseminate

The dissemination stage involves disseminating the product after validation, revision, and limited trials. The teaching module is presented in the Teacher Professional Education (PPG) seminar, explaining the background and results of the needs analysis, 4D development procedures, product characteristics, validation and trial results, and application instructions. This seminar gathers feedback from lecturers and teachers on the material's accuracy, the quality of the learning design, ease of use, and opportunities to apply the product in other contexts. Relevant input is documented as the basis for final product improvement. Digital dissemination is carried out by publishing the final product in PDF format through the official website of the Mathematics Education Study Program, Wiralodra University, namely https://pmtunwir.id. The product includes the developer's identity, learning objectives, instructions for use, materials, learning activities, LKM, assessments, and explanations of the integration of growth mindset and Deep Learning. The implementation and dissemination are evidenced through PPG seminar documentation and publication links so teachers, students, lecturers, and other interested parties can access, use, and further develop the modules.

Instruments

The research instruments were compiled based on the data needs at each stage of the 4D model. Instruments in the *define* stage identified the initial conditions and needs for product development, while instruments in the *development stage* assessed the product's validity, practicality, and effectiveness within the scope of the trial.

Define Stage Instruments

The define stage instrument consists of numeracy ability description questions, student interview guidelines, teacher interview guidelines, interview guidelines for the Vice Principal for Curriculum, and curriculum document review. Description questions are given before the student interview so that follow-up questions can be directed to the completion process that the students do. The interview guidelines are developed based on a grid containing dimensions and indicators aligned with the purpose of needs analysis. presents the details of the define-stage instrument.

Table 1. Instrument Framework for the Define Stage

Data Source	Instruments	Dimensions or indicators measured	Example
Students	Numeracy Skills Essay Questions	Use the concept of gradients and the equation of a straight line to determine the relationship between two quantities and estimate values in everyday contexts	A taxi service sets its fares based on distance traveled. For a 2-km trip, passengers pay Rp14,000.00, while for a 6-km trip, passengers pay Rp30,000.00. If the relationship between distance and taxi fare is linear, determine a) the equation for the taxi fare and b) the fare for a 10-km trip.
Students	Interview Guidelines	Understanding the context of a problem (2), formulating a problem mathematically (2), applying concepts and procedures (3), interpreting results (2), reasoning and checking answers (2), communicating mathematical processes (2), explaining learning experiences and needs regarding the module (5), and explaining attitudes and responses to difficulties (2)	After reading the questions about taxi fares, what information do you think is important for answering each question? (https://docs.google.com/document/d/1ew9gmcivCEWr4-IWC4yE8He8gT_2HYAe/edit?usp=share_link&ouid=112631215314335818227&rtpof=true&sd=true)
Mentor Teacher	Interview Guidelines	Understanding of numeracy, lesson planning, lesson delivery, the use of context and representations, experience using instructional materials, scaffolding and differentiation, assessment and	In your opinion, what is meant by numeracy skills, and why is it important to develop these skills when

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Data Source	Instruments	Dimensions or indicators measured	Example
		feedback, the application of a growth mindset, the application of Deep Learning, as well as challenges and needs for module development	learning about linear equations? (https://docs.google.com/document/d/1ew9gmcivCEWr4-IWC4yE8He8gT_2HYAe/edit?usp=share_link&ouid=112631215314335818227&rtpof=true&sd=true)
Deputy Principal for Curriculum	Interview Guidelines and Field Notes	Policies on module use, alignment with the curriculum, implementation of a growth mindset and deep learning, teacher competency development, module adaptation, resource support, assessment implementation, evaluation of implementation, as well as challenges and school needs	What is the school's policy regarding the development and use of teaching modules by teachers in classroom instruction? (https://docs.google.com/document/d/1ew9gmcivCEWr4-IWC4yE8He8gT_2HYAe/edit?usp=share_link&ouid=112631215314335818227&rtpof=true&sd=true)

Develop Stage Instruments

The instruments used during the development stage were designed to assess the product's validity, practicality, and effectiveness. Product validity was evaluated using an expert validation form covering content, instructional design, presentation and layout, language use, assessment, and the integration of a growth mindset and deep learning. Each aspect was rated on a Likert scale, with space provided for comments and recommendations for improvement. Product practicality was assessed using student response questionnaires and mentor teacher observation sheets, which addressed ease of use, clarity of instructions, readability, visual appeal, feasibility of activities, adequacy of time allocation, ease of following the scaffolding, and the module's perceived usefulness in supporting students' understanding of the material. Product effectiveness was evaluated in relation to the learning objectives using a posttest consisting of a single contextual essay question. This question required students to construct a linear model from two pairs of data and use the resulting model to estimate values under different conditions (Table 2).

Table 2. Posttest Instrument Blueprint for the Development Phase

Content indicators	Numeracy skill indicators	Assessment objectives	Cognitive level	Example
Using gradients and the equation of a	Use mathematical	Describes students' ability to determine	C3	At a school, the distance traveled by an electric

Content indicators	Numeracy skill indicators	Assessment objectives	Cognitive level	Example
straight line to determine the relationship between two quantities and estimate values	concepts, procedures, facts, and symbols to model problems and interpret the results in context	the slope, write the equation of a line, use the equation to find the values being asked for, and draw conclusions appropriate to the context		vehicle is recorded every 10 minutes. At the 10th minute, the distance is 4 km, and at the 30th minute, the distance is 10 km. Assume that the relationship between distance and time is linear. Determine the slope of this relationship, then write the equation of the line representing distance s (km) versus time t (minutes). Explain the meaning of the slope in this situation. (https://docs.google.com/document/d/1ezUoPLidC_CzgOWzKTHlAgL_TbjOXeND/edit?usp=share_link&ouid=112631215314335818227&rtpof=true&sd=true)

Student answers are evaluated using an analytical rubric with a maximum score of 8. Guidelines Assessment for Each Question: (4) The model/equation is correct; the calculation is correct; the contextual interpretation is correct and complete. (3) The model/equation is correct; there is one minor error in the calculation or interpretation. (2) The concept or model is generally correct; there are some errors in calculation or interpretation. (1) Indicates an attempt to use relevant concepts, but the model and results are incorrect. (0) Not answering, or the answer does not show the use of relevant concepts.

Analysis

The initial test data were analyzed descriptively, focusing on scores, completion rates, conceptual and procedural errors, ability to interpret results, and patterns in students' strategies. Interviews then deepened the findings by explaining why students chose a strategy, the difficulties they experienced, and the form of assistance needed. Interview data from students, teachers, and Curriculum Vice Principals were analyzed qualitatively through transcription, coding, theme grouping, data presentation, and conclusion drawing. The validity of the information was strengthened through triangulation of sources by comparing information from students, teachers, and curriculum parties, as well as triangulation of techniques by comparing test results, interviews, field notes, and curriculum documents. The analysis results were formulated into material needs, activities, media, assessments, scaffolding, differentiation, and ways to integrate growth mindset and deep learning that need to be included in the module.

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Product Validity Analysis

The expert validation data were analyzed using the Chi-Square (χ^2) test with IBM SPSS to determine whether the validators' ratings conformed to the established rating categories. The Chi-Square test compared the observed frequencies with the expected frequencies for each rating category. The analysis was carried out using SPSS at a 5% significance level ($\alpha = 0.05$) with the Chi-Square Goodness-of-Fit test. The validator assessment frequency data were entered into SPSS and analyzed to obtain χ^2 and *p-values*. We based decisions on the significance value (*Asymp. Sig.)*. If the significance value > 0.05, then there was no significant difference between the observed frequencies and the expected frequencies. Conversely, if the significance value ≤ 0.05, there is a significant difference between the observed and expected frequencies. The Chi-Square test results are then used as one basis for evaluating the suitability of the distribution of validator assessments for the developed product. In addition to quantitative analysis, the determination of product feasibility also considers comments and suggestions from validators as well as the implementation of revisions based on recommendations given by experts.

Product Practicality Analysis

The data from student response questionnaires and teacher observation sheets were analyzed using percentage scores with the following formula.

$$P = \frac{\sum S_o}{\sum S_m} \times 100$$

Description:
P : Practicality percentage.
ΣS_o : The total score obtained.
ΣS_m : Maximum score.

The percentages were then interpreted using the practicality categories established earlier. The comments from students and teachers were also analyzed qualitatively to identify the parts of the module that still needed improvement.

Product Effectiveness Analysis

The effectiveness of the piloted learning objectives was analyzed using a pre-experimental design. Furthermore, the *posttest* results were analyzed using *the Chi-Square* test (*Chi-Square Test*) with the help of IBM SPSS Statistics software. The *Chi-Square test assessed* whether the frequency distribution of student learning outcomes fit the predetermined achievement categories. The analysis compared the observed frequencies with the expected frequencies in each category. The results were used to describe students' numeracy achievement after participating in learning using the teaching module. The product is declared effective if the distribution of student achievement conforms to the set achievement criteria and the percentage of students who achieve the KKTP meets the limit specified in the study. The effectiveness of the teaching module is determined based on the results *of* the posttest *of* students' numeracy ability after the module is applied in the learning process. The post*test*

results are analyzed to determine students' numeracy achievement level based on the set effectiveness criteria. An explanation of the overall design is presented visually in Figure 1.

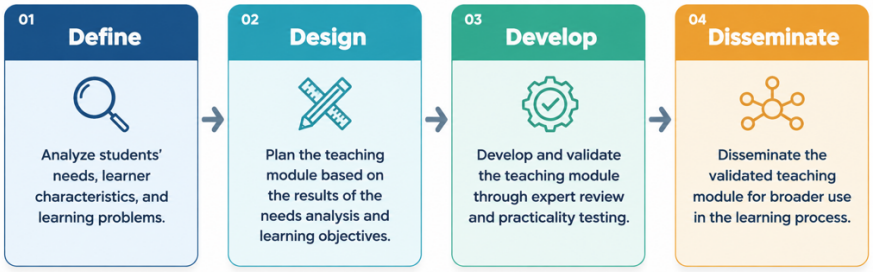


Figure 1. Results of Student Interviews

Research Findings

Define

The define stage identified students' initial conditions and product development needs based on mathematics learning problems in the field. Data collection was conducted on Tuesday, August 11, 2026, through interviews with students, one grade IX mathematics teacher, and the vice principal of the curriculum section, using 20 questions covering learning experiences, mathematics learning difficulties, and conditions related to numeracy skills. The interview data were supplemented with one initial diagnostic question to assess students' ability to understand information, apply mathematical concepts, reason, and solve contextual problems. The interview and diagnostic results were then used to determine the needs and characteristics of the product to be developed. Error! Reference source not found. and **Figure 1** present the results of the student interviews and the students' work.

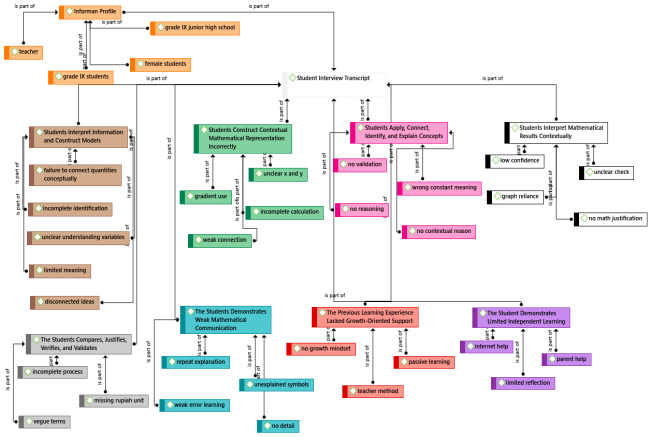


Figure 1. Results of Student Interviews

Based on the image above, the results of student interviews on the ATLAS.ti chart show that students' numeracy skills are still not optimal, especially in understanding information, compiling mathematical models, applying concepts, and interpreting and validating results. This is evident in difficulty connecting quantities and variables, using inappropriate gradients and constants, incomplete calculations, weak reasoning, and a lack of justification and examination of answers. This condition shows that students cannot apply mathematical concepts fully in problem contexts, so learning that encourages conceptual understanding,

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reasoning, communication, independence, and a growth mindset is needed to support improved numeracy skills.

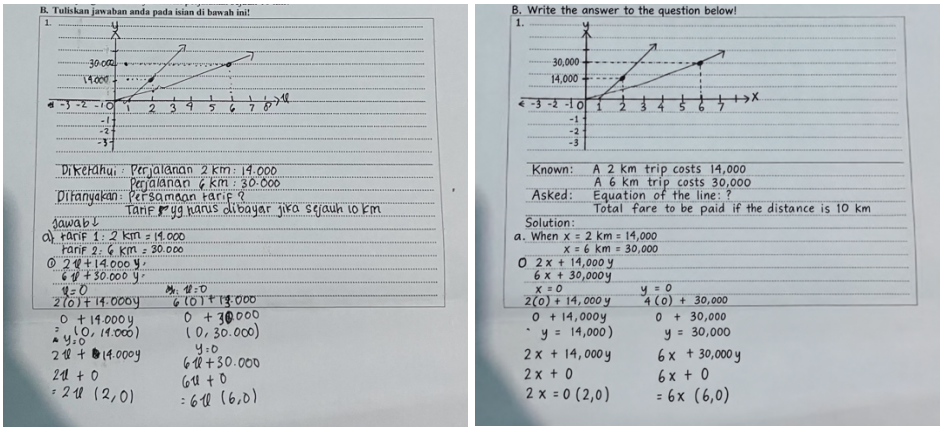


Figure 2. Students' Work

Based on the results, students could identify distance and rate information and represent it in graphs but still made mistakes in determining gradients and constructing straight-line equations. This shows that students' ability to connect representations, model problems, and apply mathematical concepts in real contexts is still not optimal.

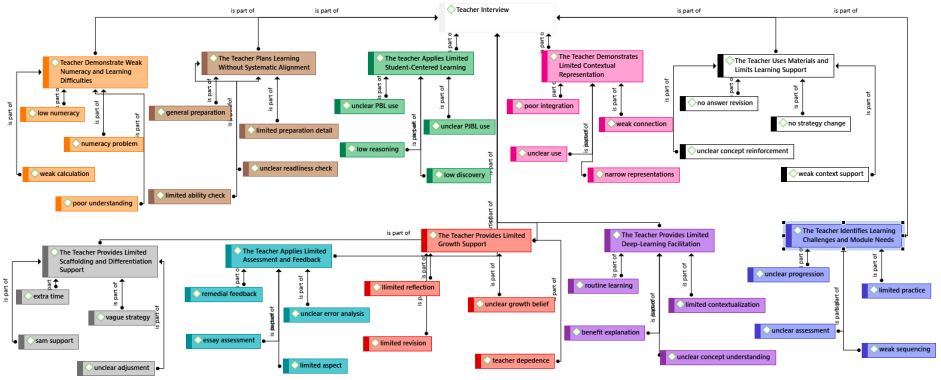


Figure 3. Results of Teacher Interviews

Interview results indicate that students' numeracy skills still face several obstacles. This is reflected in codes such as low numeracy, weak calculation, poor understanding, low reasoning, and numeracy problems. The teacher also reported that the assessment of students' initial readiness and ability has not been carried out effectively. In addition, the use of problem-based learning, discovery, context, and various mathematical representations remains limited. These findings underscore the need for teaching modules that systematically develop numeracy in a student-centered manner.

This need is reinforced by limited scaffolding and differentiation support, limited assessment and feedback, unclear error analysis, limited revision, and limited reflection. This pattern indicates that students have not received adequate support to understand their mistakes, improve their strategies, and reflect on their learning process. The "unclear growth belief" coding also underscores the need to strengthen the belief that mathematical skills can develop through effort and the right strategies. Therefore, Growth Mindset-based teaching modules need to integrate scaffolding, formative assessment, feedback, reflection, and contextual learning.

This integration is expected to improve students' numeracy skills through an active and continuous learning process.

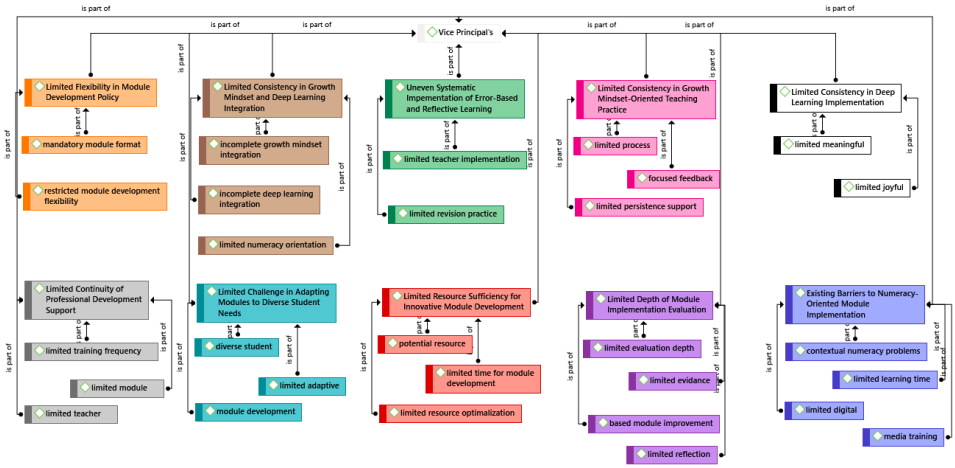


Figure 4. Results of the Interview with the Assistant Principal for Curriculum

The figure above shows that teaching module development still faces limitations in flexibility, adaptation to student needs, and the integration of Growth Mindset and deep learning. These findings are reflected in the limitations of module development, inconsistent integration of Growth Mindset, and limited numeracy orientation. In addition, error-based learning and reflection have not been implemented systematically in the learning process. This indicates the need for more adaptive and structured teaching modules that align with characteristics and needs.

Based on these findings, Growth Mindset-based teaching modules are needed to support learning that fosters perseverance, reflection, strategic improvement, and active student involvement. Modules should also include contextual numeracy activities to help students connect mathematical concepts to real-world situations. Strengthening feedback and treating mistakes as part of the learning process can help students develop a positive attitude toward challenges in mathematics. Thus, developing Growth Mindset-based modules can more effectively improve students' numeracy skills.

Design

In the Design stage, the needs analysis results serve as the basis for designing teaching materials aligned with students' characteristics, needs, and learning problems. The design focuses on numeracy skills, information understanding and modeling, reasoning and problem solving, and student learning readiness. In addition, the teaching materials are designed to integrate diagnostic assessment, *scaffolding* and differentiation, formative assessment, error analysis, and reflection as part of the learning process. The values of *Growth Mindset* and deep learning principles are also systematically combined so that students not only understand concepts but can apply them, reflect on the learning process, and face mathematical challenges positively. Based on these considerations, the teaching materials are designed by referring to general findings, identified weaknesses, and recommendations summarized in the Table 3.

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Table 1. Product Requirements Analysis

Aspects Observed	General Findings	Indications of Weakness	Recommendations for Developing Instructional Materials
Numeracy Skills	Students' numeracy skills are not yet optimal in terms of understanding, applying, and interpreting mathematical concepts.	Students have difficulty connecting information, concepts, and problem contexts.	The curriculum should include numeracy activities that are progressive, contextual, and focused on understanding and applying concepts.
Understanding Information and Modelling	Students can identify some information but are not yet fully capable of constructing mathematical models.	They have difficulty relating quantities to variables and forming mathematical equations.	Present a systematic approach to identifying information, determining variables, creating models, and solving problems.
Reasoning and Problem Solving	Students' reasoning skills are still weak, and they are not yet able to fully apply concepts to real-world contexts.	Their calculations are incomplete, their reasoning is weak, and they fail to provide sufficient justification.	Include problem-solving activities that require students to explain their reasoning, strategies, and steps for solving the problem.
Diagnostic Assessment	Assessments of students' readiness and initial abilities have not been conducted optimally.	Teachers have not systematically obtained a clear picture of students' initial abilities.	Begin the instructional material with a cognitive diagnostic assessment and, when relevant, an assessment of students' readiness to learn.
Scaffolding, Differentiation, Error Analysis, and Reflection	Support for scaffolding and differentiation is still limited, while error analysis, revision, and reflection have not yet been conducted systematically.	Students have not received adequate assistance according to their levels of difficulty and learning needs. They are also not yet accustomed to identifying the sources of their errors, revising their solutions, and refining their strategies.	Provide step-by-step guidance, examples, prompting questions, and activities with varying levels of support. Incorporate Error Analysis, Refine My Strategy, and Reflection sections after learning activities or assessments to help students recognize errors, revise their work, and improve their problem-solving strategies.
Formative Assessment and Feedback	Assessment and feedback are still limited.	Students' mistakes are not always used as a basis for improving learning.	Incorporate short quizzes, comprehension checks, immediate feedback, and opportunities to correct answers.
Growth Mindset	The belief that mathematical ability can be developed is not yet firmly established, and its integration is not yet consistent.	Students tend not to view mistakes and challenges as part of the learning process.	Integrate the principles of the Growth Mindset, gradual challenges, reflection on effort, strategies, perseverance, and the use of mistakes as learning opportunities.
Deep Learning	The integration of a growth mindset and deep learning is still inconsistent.	Learning has not yet systematically linked understanding, reflection, and application.	Design activities that promote conceptual understanding, reasoning, reflection, collaboration, and the meaningful application of concepts.

Based on the product needs analysis table, mathematics learning still faces obstacles to students' numeracy skills, especially in understanding information, modeling problems, connecting various representations, applying concepts, reasoning, and examining and reflecting on results. This is compounded by limitations in diagnostic assessment, scaffolding, differentiation, formative assessment, feedback, error analysis, and opportunities for revision. In addition, the integration of Growth Mindset, contextual learning, and deep learning has not been consistent, so students have not gained learning experiences that encourage perseverance, strategy improvement, and conceptual understanding. Therefore, the product developed needs to be adaptive, contextual, and student-centered teaching materials that integrate diagnostic assessments, numeracy activities, scaffolding, differentiation, formative assessment, feedback, error analysis, reflection, and Growth Mindset principles to support the systematic improvement of numeracy skills.

Develop

Product Validation Test

The product validation test was carried out to determine the feasibility of the teaching modules before they were applied in learning. Several experts assessed the material, media, and pedagogic aspects using the prepared instruments.

Table 4. Product Validation Test Results

Test Statistics

	Score
Chi-Square	12.862[a]
df	4
Asymp. Sig.	.012

a. 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 11.6.

Based on the *Chi-Square* test in SPSS, a *Chi-Square value* of 12.862 was obtained with a degree of freedom (*df*) = 4 and a significance value (*Asymp. Sig.*) of 0.012. Because the significance value was below the 0.05 significance level, H_0 was rejected and H_1 was accepted. These results showed a significant difference between the observed and expected frequencies. The findings indicate that the validator assessment results show a pattern significantly different from the expected distribution, supporting fulfillment of the product validity criteria. Thus, the test results show that the developed product has met the validity criteria for implementation in learning.

Product Practicality Test

The practicality test gathered information on the ease of use, implementation, and acceptance of the product developed during the learning process. Practicality data were collected through student responses and teachers' observation sheets after the product was implemented, providing a basis for assessing the product's practical feasibility.

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Table 5. Practical Test Results

Category	Student Response		Observer Response	
	N	Percentage	N	Percentage
1	11	2%	0	0
2	10	2%	0	0
3	122	20%	0	0
4	271	45%	2	20%
5	186	31%	8	80%
		76%		100%

The practicality test results showed that students' responses were dominated by categories 4 and 5 (45% and 31%, respectively), for a total positive response of 76%. Meanwhile, category 3 accounted for 20%, while categories 1 and 2 accounted for 2% each. Based on teachers' observations, 20% of indicators were in category 4 and 80% in category 5, showing that product implementation in learning was going well. The dominance of responses in categories 4 and 5 from students and observers indicated that the product was relatively easy to use and could be applied according to the learning design. Thus, the practicality test results showed that the developed product had an adequate level of practicality for use in the learning process.

Product Effectiveness Test

An effectiveness test was conducted to determine the extent to which the instructional module, developed based on the Growth Mindset and the integration of deep learning, could improve students' numeracy skills. The test analyzed students' learning outcomes after using the module to provide empirical evidence of its effectiveness in achieving the learning objectives.

Table 6. Results of the Effectiveness Test

Criteria for Achieving Learning Objectives * Crosstabulation
Numeracy Ability

Count				
		Numeracy Ability		Total
		1	2	
Criteria for Achieving Learning Objectives	38	0	1	1
	63	0	1	1
	75	5	0	5
	88	8	0	8
	100	15	0	15
Total		28	2	30

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	30.000[a]	4	<.001
Likelihood Ratio	14.696	4	.005
Linear-by-Linear Association	15.459	1	<.001
N of Valid Cases	30		

Based on the analysis of 30 students, 28 students (93.33%) were in numeracy ability category 1, while 2 students (6.67%) were in numeracy ability category 2. The distribution showed that most students had reached the expected numeracy ability category after using the developed teaching module. The Pearson *Chi-Square* test yielded a score of 30,000 with $df = 4$ and $p < 0.001$, indicating a significant relationship between the KKTP criteria and students' numeracy ability. These findings show that students' numeracy achievement tends to be in the higher category at higher KKTP scores. Thus, the test results show that the developed products effectively support students' numeracy achievement.

Disseminate

At the dissemination stage, the product in the form of a Growth Mindset-based teaching module that has gone through the stages of validation, practicality, and effectiveness is disseminated more widely to relevant users. Dissemination is carried out by uploading the teaching module on the website of the Mathematics Education Study Program of Wiraloda University (PMT UNWIR), namely https://pmtunwir.id/berita/modul-ajar-berbasis-growth-mindset-terintegrasi-pembelajaran-mendalam-pada-materi-persamaan-garis-lurus-kelas-viii-smp-14. This upload aims to make the product accessible to teachers, students, and other parties who need references to Growth Mindset-based mathematics teaching modules. Through website dissemination, this product is expected to expand the use of the development results and become one of the learning resources used in mathematics learning. Thus, the dissemination stage is the final step to disseminate the product so that it can be used more widely outside the development environment.



Figure 6. Module Cover and Module Display in PMT Unwir Web

Discussion

The results of the study at the define stage indicate that students' numeracy skills are not optimal for understanding information, building mathematical models, relating representations, applying concepts, reasoning, and examining and reflecting on results. Therefore, contextual, adaptive, and student-centered teaching materials are needed. This finding aligns with the latest PISA framework, which emphasizes students' ability to apply knowledge and skills to real-world problems, while the PISA mathematics framework places the processes of formulating, using, interpreting, and evaluating mathematics at the core of mathematical literacy Student

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characteristics analysis, needs analysis, and material analysis then serve as the basis for determining learning objectives and module characteristics aligned with students' readiness and learning difficulty levels. In addition Dong et al. (2023) show that growth mindset does not directly predict mathematical achievement but is related to achievement through intrinsic motivation, attribution to failure, mathematical self-efficacy, and mathematical anxiety. Therefore, the define stage is the basis for determining the need for modules that are not only oriented toward conceptual mastery but also support the processes of thinking, perseverance, reflection, and the use of mathematics in a meaningful context.

The design stage translates the needs analysis results into module design through gradual numeracy activities that include diagnostic assessment, scaffolding, differentiation, formative assessment, error analysis, reflection, contextual learning, and the application of Discovery Learning, Problem-Based Learning, and Cooperative Learning. Ikram et al. (2024) support the suitability of contextual teaching material design for developing mathematical skills by developing a mathematics book based on Realistic Mathematics Education in the context of Luwu tourism and demonstrating improvements in reasoning skills and students' understanding of information and mathematical argumentation. The module's learning design directs students not only to receive information but also to explore concepts, solve problems, work together, communicate strategies, and reflect on the learning process. Juli et al. (2025) also found that Problem-Based Learning-based mathematics teaching modules developed using the 4D model meet valid, practical, and effective criteria to support students' mathematical literacy skills. Thus, the design stage produces a learning structure that integrates numeracy orientation, Growth Mindset, deep learning, active learning strategies, assessment, feedback, and reflection.

The development stage involves expert validation, product revision, practicality testing, and effectiveness testing to ensure the module meets the set development criteria. The results align with Ceylan Oral (2025)**,** which found a significant positive relationship between growth mindset and academic perseverance, attitude toward mathematics, and mathematical achievement, as well as a negative relationship with mathematics anxiety among eighth-grade students. In this study, the module met the validity criteria, received a positive student response of 76%, and had 100% teacher implementation. The results of the analysis of the student response questionnaire showed that the aspects *of growth mindset* and learning persistence recorded eight low-value responses, while the aspects of mathematical reasoning and contextual numeracy and collaboration recorded five responses each, while the other three aspects recorded one response each. These findings are relevant to the study of van Hoeve et al. (2025) which discussed the development of *a growth mindset* in mathematics learning in secondary school as part of students' learning experiences. The variation in responses provided an overview of students' experiences in facing challenges, applying mathematical concepts to contextual situations, and participating in collaborative activities. In line with this, Fauzan et al. (2024) examined the contribution of realistic mathematical approaches to literacy and numeracy, while Karina et al. (2025) examined the application of cooperative learning to support the mathematics achievement of secondary school students. Thus, the results of this questionnaire became a constructive evaluation material to optimize the implementation of modules through learning experiences that encourage perseverance, contextual reasoning, and student collaboration. The effectiveness test showed that 28 of 30 students (93.33%) were in numeracy ability category 1, with a significant relationship between KKTP and numeracy ability ($p < 0.001$). However, Macnamara & Burgoyne (2023) a systematic review and meta-analysis found no significant evidence that high-quality Growth Mindset interventions affect academic achievement, so its effect needs careful interpretation. Thus, the modules'

effectiveness is better understood as the result of integrating Growth Mindset with learning strategies, scaffolding, assessment, feedback, reflection, deep learning, and numeracy activities, rather than as the effect of Growth Mindset as a single intervention.

In addition to producing products that meet the development criteria, integrating growth mindset, deep learning, and numeracy orientation in the module highlights the importance of the relationship between cognitive and noncognitive aspects in mathematics learning. A learning environment that gives students opportunities to face challenges, try different strategies, receive feedback, and gradually correct mistakes can support student involvement in the learning process. Vestad & Bru (2024) show that teacher support for growth mindset is related to students' growth mindset and academic engagement, which in turn is related to academic achievement at the junior high school level. These findings strengthen the design of this research module by not treating growth mindset as a motivational message alone, but by integrating it into problem-solving activities, reflective questions, error analysis, the use of various strategies, and opportunities to improve answers. In contrast, Bui et al. (2023) emphasized that mindset interventions in mathematics learning are more relevant when they are tied to the subject context and do not stand apart from classroom learning practices. This aligns with the module design, which combines growth mindset with active learning approaches, scaffolding, assessments, and numeracy activities so changes in students' learning experiences target not only belief in their abilities but also how they approach mathematical challenges. Thus, the results show that integrating a growth mindset is more meaningful when it is realized through learning experiences that allow students to practice facing difficulties, try again, receive feedback, and reflect on the strategies used.

Diagnostic assessments, formative assessments, feedback, and reflection in modules are also important components in ensuring learning can adjust to students' needs and development. Maskos et al. (2025), through a systematic review of 45 studies, showed that formative assessments in mathematics education can provide information about students' learning conditions, which are then used to adjust learning, although their effectiveness is influenced by the quality of implementation, clarity of learning objectives, characteristics of learners, and the form of feedback provided. Furthermore, Zhang & Cai (2021) showed that problem posing activities have a positive impact on cognitive and non-cognitive outcomes and are more optimal when problems are presented in a meaningful context, while Wang et al. (2022), through meta-analysis, also showed that problem posing is related to the development of mathematics learning performance and disposition. In this study, the findings strengthen the decision to develop modules with contextual problems, exploration activities, strategy communication, and reflection as a series of learning experiences. Komarudin et al. (2024) They also show that learning approaches that encourage reading, information organization, discussion, and strategy sharing can support students' mathematical literacy skills, while Chen et al. (2024) show that the relationship between growth mindset and mathematics achievement can occur through adaptive characteristics such as academic buoyancy and adaptability. Thus, the results of this study show that developing numeracy-oriented mathematics modules is better understood as a learning ecosystem that integrates concept understanding, modeling, communication, problem-solving strategies, learning regulation, perseverance, feedback, and reflection.

The disseminate stage is carried out by uploading modules on the PMT UNWIR page so that they can be accessed by teachers, students, and other users as a Growth Mindset-based mathematics learning resource. This practice aligns with Oktaviana et al. (2025), who developed learning tools using the 4D model and disseminated teaching modules through online platforms for wider use. Disseminating modules at this stage not only serves as a product

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publication but also opens opportunities for other users to use contextual, active teaching materials oriented toward numeracy skills. Sufriadi et al. (2025) also showed that developing mathematics modules based on real-world problems using a 4D model can bridge mathematical concepts with authentic contexts and support students' ability to model and apply mathematics in real situations.

Overall, the application of the 4D approach resulted in the development of instructional modules based on students' learning needs, integrating a growth mindset, deep learning, and the reinforcement of numeracy skills. In the "Linear Equations" unit, numeracy focuses on the ability to understand contextual information, identify relationships between quantities, determine and interpret slopes, construct equations from real-world situations, connect tables, graphs, and equations, and use reasoning to derive and evaluate solutions. The define stage identifies students' needs and challenges, design produces contextual, student-centered learning, develop involves validation and pilot testing and disseminate focuses on distributing the refined product. The development results show that the module meets the criteria of being valid, practical, and effective, making it suitable for use in supporting the learning of linear equations and strengthening numeracy skills through meaningful, contextual, and reflective learning experiences.

Conclusion

Based on the development process and research results, the integrated teaching module *Growth Mindset* and Deep Learning for the Straight-Line Equation material has been developed as a teaching resource to strengthen junior high school students' numeracy skills. The results of the product evaluation showed that the module met the validity with a chi-square goodness-of-fit score of 12.862, achieved a practicality score of more than 75%, and demonstrated effectiveness with an effectiveness Chi-Square score of 30,000. Integrating Growth Mindset gives students space to build confidence that mathematical skills can develop through effort, strategy, and reflection, while Deep Learning encourages meaningful conceptual understanding through student-centered, contextual activities. The Straight-Line Equation material is presented through activities that encourage students to connect various mathematical representations, apply concepts in real situations, and solve problems systematically. Thus, this module not only functions as a learning resource but also as a learning tool that supports the development of students' mathematical thinking processes and numeracy skills. Overall, the module's development shows that integrating Growth Mindset and Deep Learning can be a relevant approach to designing meaningful, numeracy-oriented mathematics learning. Nevertheless, this study has several limitations. The effectiveness evaluation was conducted using a one-shot case study design and therefore did not involve a comparison group or pretest–posttest measurement. In addition, the study focused on students' numeracy achievement after learning with the developed module, while Growth Mindset was positioned as an instructional foundation rather than as a measured dependent variable. The implementation was also limited to a specific group of students and the Straight-Line Equation topic, which may limit the generalizability of the findings to other contexts and mathematics topics.

The implications of this study show that teachers can use the developed teaching modules as alternative teaching materials to create more contextual, active, reflective, and student-centered learning of straight-line equations. The Growth Mindset element can encourage students to be more open to mistakes, try various strategies, and not give up easily when facing mathematical problems, while Deep Learning strengthens the connection between

mathematical concepts and real-life situations, so learning does not stop at mastering procedures. This module can also serve as a reference for schools in developing learning tools that strengthen numeracy and improve the quality of mathematics learning. Teachers can use the modules as teaching materials that support meaningful learning while developing students' mathematical thinking skills. For future researchers, these results can serve as a basis for developing similar modules on other mathematics materials, with a wider range of subjects, more diverse evaluation designs, and measurement of learning impact over a longer period.

Declarations

Conflict of Interest	:	The authors declare that there are no conflicts of interest.
Auhor Contributions	:	M.F.F.: Conceptualization, Methodology, Investigation, Resources, Data curation, Formal analysis, Writing – original draft, Writing – review & editing. F.G.: Supervision, Methodology, Writing – review & editing. N.: Supervision, Investigation, Writing – review & editing. E.T.: Investigation, Resources, Writing – review & editing. R.: Writing – review & editing.
Data Availability Statement	:	The data supporting the findings of this study are available from the corresponding author, F.G., upon reasonable request
AI Statement	:	The authors declare that generative AI tools were used to assist in drafting and revising selected portions of the manuscript and to improve the clarity, grammar, and readability of the English language. All AI-assisted content was reviewed and revised by the authors, who take full responsibility for the accuracy, originality, and integrity of the final manuscript.

References

Andriani, B. P., Setialesmana, D., & Herawati, L. (2026). Analysis of Students' Mathematical Semiotic Representation Ability in Terms of Self-Confidence. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *6*(3), 1197–1209. https://doi.org/10.51574/kognitif.v6i3.5238

Anggraini, R., Sadieda, L., & Hidayati, N. (2025). Pengembangan Modul Ajar Deep Learning untuk Meningkatkan Hasil Belajar. *J-PiMat : Jurnal Pendidikan Matematika*, *7*, 1839–1850. https://doi.org/10.31932/j-pimat.v7i2.5416

Astuti, E. P., Wijaya, A., & Hanum, F. (2024). Characteristics of junior high school teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. *Journal of Pedagogical Research*, *8*(1), 244–268. https://doi.org/10.33902/JPR.202423405

Boaler, J., Dieckmann, J. A., LaMar, T., Leshin, M., Selbach-Allen, M., & Pérez-Núñez, G. (2021). The Transformative Impact of a Mathematical Mindset Experience Taught at Scale. *Frontiers in Education*, *6*. https://doi.org/10.3389/feduc.2021.784393

Bolstad, O. H. (2023). Lower secondary students' encounters with mathematical literacy. *Mathematics Education Research Journal*, *35*(1), 237–253. https://doi.org/10.1007/s13394-021-00386-7

Bui, P., Pongsakdi, N., McMullen, J., Lehtinen, E., & Hannula-Sormunen, M. M. (2023). A systematic review of mindset interventions in mathematics classrooms: What works and what does not? In *Educational Research Review* (Vol. 40). Elsevier Ltd. https://doi.org/10.1016/j.edurev.2023.100554

Ceylan Oral, S. (2025). Exploring the Impact of Growth Mindset on Mathematics Achievement, Attitudes and Anxiety in Middle School Students. *International Journal of Research in Teacher Education (IJRTE)*, *16*(4), 1–13. https://doi.org/10.29329/ijrte.2024.1408.01

Chen, M., Mok, I. A. C., Cao, Y., Wijaya, T. T., & Ning, Y. (2024). Effect of Growth Mindset on Mathematics Achievement Among Chinese Junior High School Students: The Mediating Roles of Academic Buoyancy and Adaptability. *Behavioral Sciences*, *14*(12). https://doi.org/10.3390/bs14121134

Dong, L., Jia, X., & Fei, Y. (2023). How growth mindset influences mathematics achievements: A study of Chinese middle school students. *Frontiers in Psychology*, *14*, 1. https://doi.org/10.3389/fpsyg.2023.1148754

Fauzan, A., Harisman, Y., Yerizon, Suherman, Tasman, F., Nisa, S., Sumarwati, Hafizatunnisa, & Syaputra, H. (2024). Realistic Mathematics Education (RME) to Improve Literacy and Numeracy Skills of Elementary School Based on Teachers' Experience. *Infinity Journal*, *13*(2), 301–316. https://doi.org/10.22460/infinity.v13i2.p301-316

Getenet, S. T. (2022). Teachers' Knowledge Framework for Designing Numeracy Rich Tasks across Non-Mathematics Curriculum Areas. *International Journal of Education in Mathematics, Science and Technology*, *10*(3), 663–680. https://doi.org/10.46328/ijemst.2137

Hammadi, S. S., Majeed, B. H., & Hassan, A. K. (2023). Impact of Deep Learning Strategy in Mathematics Achievement and Practical Intelligence among High School Students. *International Journal of Emerging Technologies in Learning*, *18*(6), 42–52. https://doi.org/10.3991/ijet.v18i06.38615

Hariyono, E., Madlazim, Hidaayatullaah, H. N., & Ichinose, T. (2024). Enhancing decision-making skills through geoscience education for sustainable development. *International Journal of Evaluation and Research in Education* , *13*(3), 1885–1894. https://doi.org/10.11591/ijere.v13i3.26300

Ikram, M., Marufi, M., & Canne, S. (2024). Design of an RME-Based Fractions Textbook in the Luwu Tourism Context to Stimulate Students' Reasoning Skills. *ETDC: Indonesian Journal of Research and Educational Review*, *3*(4), 232–255. https://doi.org/10.51574/ijrer.v3i4.4327

Jatmiko, D. D. H., & Lestari, N. D. S. (2025). Pengembangan Modul Elektronik Berbasis Geogebra Book Pada Materi Persamaan Garis Lurus untuk Melatih Literasi Digital Siswa. *EDU-MAT: Jurnal Pendidikan Matematika*, *13*(2), 345. https://doi.org/10.20527/edumat.v13i2.23193

Juli, S. F., Muin, A., & Kustiawati, D. (2025). Pengembangan Modul Ajar Materi Peluang dengan Problem Based Learning untuk Kemampuan Literasi Matematis Siswa. *SIGMA: Jurnal Pendidikan Matematika*, *17*(1), 90–104. https://doi.org/10.26618/sigma.v17i1.17228

Karina, L., Runtu, P. V. J., & Maukar, M. G. (2025). Effectiveness of the Teams Games Tournament (TGT) Cooperative Learning Model on Students' Mathematics Achievement. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *5*(3), 1303–1314. https://doi.org/10.51574/kognitif.v5i3.3457

Kolar, V. M., & Hodnik, T. (2021). Mathematical literacy from the perspective of solving contextual problems. In *European Journal of Educational Research* (Vol. 10, Number 1, pp. 467–483). Eurasian Society of Educational Research. https://doi.org/10.12973/EU-JER.10.1.467

Komarudin, K., Suherman, S., & Vidákovich, T. (2024). The RMS teaching model with brainstorming technique and student digital literacy as predictors of mathematical literacy. *Heliyon*, *10*(13). https://doi.org/10.1016/j.heliyon.2024.e33877

Macnamara, B. N., & Burgoyne, A. P. (2023). Supplemental Material for Do Growth Mindset Interventions Impact Students' Academic Achievement? A Systematic Review and Meta-Analysis With Recommendations for Best Practices. *Psychological Bulletin*, *149*(3–4), 133–173. https://doi.org/10.1037/bul0000352.supp

Maskos, K., Schulz, A., Oeksuez, S. S., & Rakoczy, K. (2025). Formative Assessment in Mathematics Education: A Systematic Review. *ZDM - Mathematics Education*, *57*(4), 679–693. https://doi.org/10.1007/s11858-025-01696-x

Maulina, S., Junaidi, J., Nufus, M., & Maulida, N. R. (2024). Students' Mathematical Literacy through Ethnomathematics-based Learning. *Jurnal Didaktik Matematika*, *11*(1), 58–73. https://doi.org/10.24815/jdm.v11i1.35676

Nugraha, D., & Yulianti, K. (2025). Penggunaan Model Problem-Based Learning untuk Meningkatkan Kemampuan Koneksi Matematis dan Growth Mindset Matematika Peserta Didik SMP. *SIGMA: Jurnal Pendidikan Matematika*, *12*(2), 112–129. https://doi.org/10.17509/sigmadidaktika.v%vi%i.80938

OECD. (2023). *PISA 2022 Assessment and Analytical Framework*. OECD Publishing. https://doi.org/10.1787/dfe0bf9c-en

OECD. (2026). *PISA 2025 Assessment and Analytical Framework*. OECD Publishing. https://doi.org/10.1787/86c36975-en

Oktaviana, T., Gunadi, F., Rosyadi, & Trapsilawati, E. (2025). Desain Pembelajaran Materi Transformasi Geometri dengan Model Problem Based Learning Terhadap Pemahaman Konsep Dilatasi. *Imajier: Jurnal Matematika Dan Pendidikan Matematika*, *7*(4), 189–197. https://doi.org/10.26877/imajiner.v7i4.22710

Rahayu, C., Setiani, W. R., Yulindra, D., & Azzahra, L. (2025). Pendidikan Matematika Realistik Indonesia dalam Pembelajaran Mendalam (Deep Learning): Tinjauan Literatur. *Jurnal Pendidikan Matematika Universitas Lampung*, *13*(1), 9–25. https://doi.org/10.23960/mtk/v13i1.pp9-25

Sadat, A., Alam, S., Ma'rufi, M., & Taufiq, T. (2026). Determinants of Students' Mathematics Achievement: The Roles of Critical Thinking, Self-Efficacy, and Metacognitive Awareness Through Achievement Motivation. *Kognitif: Jurnal Riset HOTS Pendidikan Matematika*, *6*(1). https://doi.org/10.51574/kognitif.v6i1.4128

Santos, R. A., Collantes, L. M., Ibañez, E. D., Ibarra, F. P., & Pentang, J. T. (2022). Innate Mathematical Characteristics and Number Sense Competencies of Junior High School Students. *International Journal of Learning, Teaching and Educational Research*, *21*(10), 325–340. https://doi.org/10.26803/ijlter.21.10.18

Setiawan, A., Sukestiyarno, Y. L., Man, Y. L., Marfu'Ah, S., & Wati, Y. I. (2023). Mathematical literacy ability: How in terms of self-efficacy? *AIP Conference Proceedings*, *2614*. https://doi.org/10.1063/5.0125789

Setiyani, Waluya, S. B., Sukestiyarno, Y. L., Cahyono, A. N., & Santi, D. P. D. (2024). Assessing numeracy skills on flat shapes and scaffolding forms in junior high school.

Kognitif: Jurnal Riset HOTS Pendidikan Matematika
https://doi.org/10.51574/kognitif.v6i4.5957 Volume 6, Issue 4, October - December 2026, pp. 1765 –1791

International Journal of Evaluation and Research in Education , *13*(1), 422–432. https://doi.org/10.11591/ijere.v13i1.25186

Siti Kholisah, Qohar, A., & Hery Susanto. (2024). Pengembangan E-Modul Interaktif Berbasis Android Pada Materi Persamaan Garis Lurus. *JIPMat*, *9*(1), 103–115. https://doi.org/10.26877/jipmat.v9i1.454

Sufriadi, D., Nay, F. A., & Ghazanfar, S. (2025). Development of a Real-World Problem-Based Mathematics Module to Enhance Mathematical Modeling Skills. *International Journal of Science and Mathematics Education*, *2*(1), 28–36. https://doi.org/10.62951/ijsme.v2i1.260

Susanta, A., Sumardi, H., Susanto, E., & Retnawati, H. (2023). Mathematics literacy task on number pattern using Bengkulu context for junior high school students. *Journal on Mathematics Education*, *14*(1), 85–102. https://doi.org/10.22342/JME.V14I1.PP85-102

Usmeldi, U., & Amini, R. (2022). Creative project-based learning model to increase creativity of vocational high school students. *International Journal of Evaluation and Research in Education*, *11*(4), 2155–2164. https://doi.org/10.11591/ijere.v11i4.21214

van Hoeve, M., Doorman, M., & Veldhuis, M. (2025). Fostering a growth mindset in secondary mathematics classrooms in the Netherlands. *Research in Mathematics Education*, *27*(1), 92–113. https://doi.org/10.1080/14794802.2023.2241433

Vestad, L., & Bru, E. (2024). Teachers' support for growth mindset and its links with students' growth mindset, academic engagement, and achievements in lower secondary school. *Social Psychology of Education*, *27*(4), 1431–1454. https://doi.org/10.1007/s11218-023-09859-y

Wang, M., Walkington, C., & Rouse, A. (2022). A Meta-Analysis on the Effects of Problem-Posing in Mathematics Education on Performance and Dispositions. *Investigations in Mathematics Learning*, *14*(4), 265–287. https://doi.org/10.1080/19477503.2022.2105104

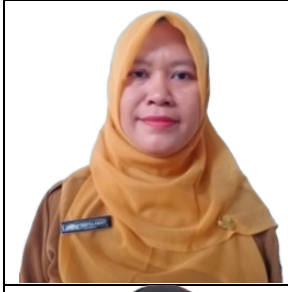
Wijaya, A. (2023). Kemampuan numerasi dan Growth Mindset siswa SMP dan Madrasah Tsanawiyah di Kabupaten Purworejo. *Jurnal Riset Pendidikan Matematika*, *10*(2), 153–164. https://doi.org/10.21831/jrpm.v10i2.66831

Zhang, H., & Cai, J. (2021). Teaching mathematics through problem posing: insights from an analysis of teaching cases. *ZDM – Mathematics Education*, *53*(4), 961–973. https://doi.org/10.1007/s11858-021-01260-3

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