e-ISSN 2795-3272
p-ISSN 2795-3264

10.5281/zenodo.14599625 Vol. 08 Issue 01 Jan - 2025 Manuscript ID: #01711

Implications of understanding by design in developing problem-based learning models with a teaching at the right level (TaRL) approach on the subject of arithmetic rows

USMADI[1], ASRIZAL[2], ERGUSNI[3]
[1,2,3]Muhammadiyah University West Sumatera, Padang, Indonesia
Emails: *[1]usmadi3012@gmail.com, [2]asrizalzal@gmail.com, [3]ergusni12@gmail.com*

Abstract

This research attempts to develop innovative learning models that address students' concerns in the classroom. The development process employs the Understanding by Design (UbD) method with the following steps: 1) identify problems in learning, 2) determine assessment evidence, 3) plan learning. The results of this development research are: 1. Problem Based Learning Model with Teaching at the Right Level (TaRL) Approach on the subject of arithmetic rows, 2. Assessment results; Assessment for learning and assessment as learning. The syntax of the Problem-Based Learning (PBL) Model with the Teaching At The Right Level (TaRL) Approach on arithmetic row material is: 1) Preliminary Activities; Orientation, perception, providing simpler questions, providing meaningful comprehension, providing motivation, orienting learners to problems (Syntax 1 PBL); 2) Core Activities; Organizing learners to learn (Syntax 2 PBL),Guiding students both individually and in groups (Syntax 3 PBL), Assisting students develop and present work (Syntax 4 PBL), Helping students to analyse and evaluate the problem-solving process (Syntax 5 PBL); 3) Concluding Activities; Help learners analyse and evaluate the problem-solving process (Syntax 5 PBL). The results of the assessment provide an overview that all learning objectives are generally achieved, while the results obtained from assessment as learning in the form of reflection on the learning process and self-reflection of students show a positive response, this can be seen from the answers written by students on the reflection sheet. In general, the students are pleased with the learning model applied.

Keywords:

Understanding by Design, Learning Model, Learning Model Syntax, Assessment.

***How to cite*:** USMADI, U., ASRIZAL, A., & ERGUSNI, E. (2025). Implications of understanding by design in developing problem-based learning models with a teaching at the right level (TaRL) approach on the subject of arithmetic rows. *GPH-International Journal of Educational Research*, 8(01), 68-96. https://doi.org/10.5281/zenodo.14599625

INTRODUCTION

Education is expected to be conducted intentionally and with proper planning to create a learning environment where students can actively develop their potential. In addition, the goals are for students to cultivate faith and devotion to Allah SWT, develop noble character, maintain good health, gain knowledge, and become capable, creative, and independent. Ultimately, education aims to produce democratic and responsible citizens, as outlined in the Law of the Republic of Indonesia No. 20 concerning the National Education System of 2003. Therefore, this implies that optimising the role of educators in educational institutions is essential for enhancing the quality of education, particularly in the learning processes and outcomes. There are several categories which can improve the quality of learning processes and outcomes in schools, such as (1) professional educators, (2) student motivation, (3) curriculum materials, and (4) quality and type of individuals who support the learning process in the classroom (Danim (2011: 100); Usmadi (2022:1)).

The purpose of developing innovative learning models for the classroom is expected to adhere to the pattern of scientific methods, which are as follows: (1) learning is centred on student activities; (2) students are offered the freedom to think critically and creatively about problems, develop problem-solving strategies, and freely and openly propose ideas; (3) educators train and guide students to think critically and creatively about problems; (4) educators arrange study groups to organise and help students communicate using graphs, diagrams, schemes, and variables; and (5) all work results are always presented in front of the class to identify various concepts, problem-solving outcomes, and mathematical rules discovered during the learning process (Usmadi: 2022: 2).

Only an effective and professional educator can provide a high-quality learning experience while adhering to the principles of the scientific method because the teacher can encourage learners to take charge of their learning experienceby fostering a welcoming environment that will enable them to excel in their studies (Cohen &; Manion, 1990: 230; Arends, I Ricard, 2004:157). In the same vein, Clark (in Mudjiran, 2011: 33) stresses that educators should have the following qualities: (a) Understand how students learn effectively, assist them in developing their intellectual, social and personality skills, and acknowledge the diversity among students to offer suitable learning support; and cultivate motivation both individually and in groups, (b) promote positive, self-driven social interactions, and communicate effectively during classroom instruction.

An exceptional and professional educator can design diverse learning experiences that enhance students' motivation to engage in the learning process. They ensure that students' thinking skills improve to become active, creative, innovative, and capable of leading fulfilling lives and consistently teach the students with sincerity and dedication during the teaching process. Moreover, the excellent educator is also perceived as one who can skilfully interact with the students, able to employ an approach that gives an extraordinary touch and become a guide by numerous outstanding figures, such as the Qur'an. Last, a skilled educator should be capable of managing time effectively and efficiently throughout the learning process (Usmadi, 2022: 6); (Elfindri, 2010:111); (Ashori et al., 2012: 36). These qualities indicate that professional educators are those who can quench their students' thirst for knowledge, serve as role models, and foster students' faith and devotion. Such educators

produce quality graduates and contribute to enhancing educational standards by creating innovative learning models

Improving the quality of education hinges on educators' ability to identify and address student issues. In mathematics learning, these issues include: (1) managing students with problems and special needs, (2) establishing relationships with students, (3) implementing positive discipline, (4) providing constructive feedback, (5) utilizing effective learning models and methods, (6) addressing motivation challenges, (7) teaching High Order Thinking Skills (HOTS) material, (8) enhancing numeracy literacy, (9) correcting misconceptions, (10) integrating technology in learning, (11) conducting assessments, (12) interacting with parents, and (13) employing innovative learning models (Usmadi: 2024).

Based on observations and peer interviews, students encounter several issues in mathematics learning, including difficulties in grasping concepts, inaccuracies in task-solving, and a lack of interest in the subject. These findings are consistent with Sihombing's (2020) research. Additionally, Puspitasari (2022) notes that using inappropriate media and learning models exacerbates these problems. To address these challenges, researchers have identified a more effective and efficient method for teaching arithmetic sequences: the Problem-Based Learning (PBL) model combined with the Teaching at the Right Level (TaRL) approach. This model effectively tackles students' difficulties in mathematics. Setyawan (2022) also supports the notion that the PBL model can enhance student learning outcomes.

Given the aforementioned issues, enhancing the quality of the learning process necessitates the development of an innovative learning model. The Problem-Based Learning (PBL) model combined with the Teaching at the Right Level (TaRL) approach is proposed to address the challenges faced by students in the classroom. One effective method for developing this model is the Understanding by Design (UbD) framework. The UbD method employs a process known as backward design, which begins with defining learning objectives and identifying problems, followed by determining assessment evidence, and ultimately developing the PBL model with the TaRL approach (Wiggins & McTighe, 2005).

DEVELOPMENT METHOD

The development method used in developing a Problem-Based Learning Model with a Teaching At The Right Level (Tarl) Approach is the Understanding by Design (UbD) development model. Understanding by Design (UbD) is a framework that prioritizes deep comprehension. In this context, understanding goes beyond surface knowledge and encompasses a thorough and holistic grasp of all aspects related to that knowledge. For instance, an educator explains the concept of Arithmetic Rows, if a student employs the Understanding by Design (UbD) framework, students not only comprehend the definition of rows but also can understand them thoroughly such as the definition of rows, the basic concept of rows, the relationship between rows and functions, the differences between rows and sets, and how to apply rows in everyday life. This approach stands in contrast to traditional learning methods where the primary focus is on the content or learning material in which students are expected to absorb.

The Understanding by Design (UbD) method employs a process known as backward design. This is called backward design because it involves remembering the tasks to be accomplished, figuring out how to achieve them, and planning structured training. In contrast to many educators who typically base their teaching on textbooks, predefined lessons, and time-consuming activities without directly tying the students to specific goals or standards, UbD starts by defining the intended result, such as learning objectives or standards. These objectives then inform the development of learning evidence through assessments. Only after this step does the planning of learning activities and experiences occur within the UbD framework (Wiggins & McTighe, 2005).

The flow of procedures for developing innovative learning models based on Understanding by Design is illustrated in Figure 1 below:

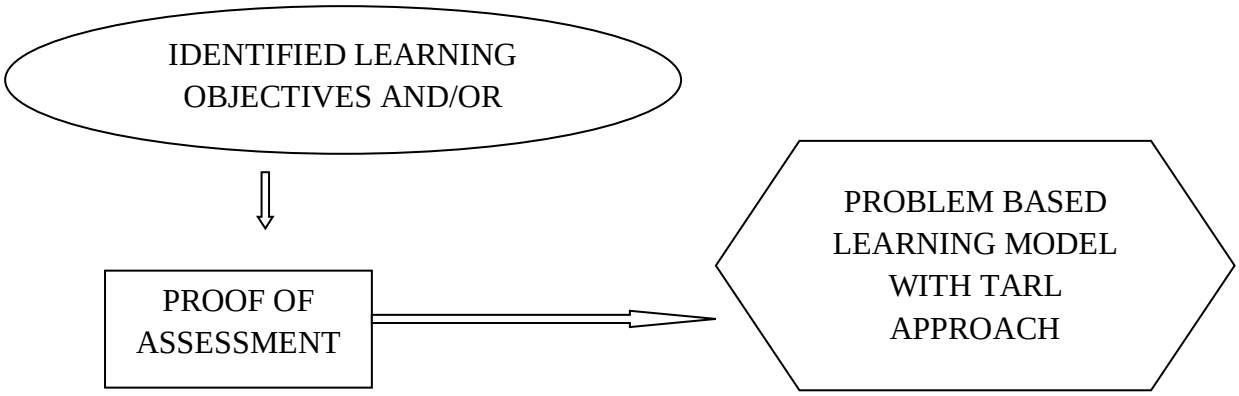

Figure 1. Understanding by Design Development Procedure

DEVELOPMENT STEPS

Stage 1. Identify Intended Outcomes

The first stage is aimed at evaluating the learning objectives determined by the national curriculum and reviewing the curriculum expectations. There's often a vast amount of material to cover, which may not fit into the available time. Learning priorities should be set based on long-term performance, ensuring that learners can apply what they've learned. Understanding by Design (UbD) emphasizes the ability to transfer knowledge to real-life situations and outstanding students excel in the classroom and apply their knowledge in various environments. To foster a responsive attitude and deeper understanding in students, educators must craft essential questions. These questions prompt learners to think critically about how to achieve their goals.

Stage 2. Determine Evidence of Assessment

The goal of the second stage is to prove that learners have achieved the target results in meeting the standard and demonstrate the methods used by the educator to assess whether learners have achieved the desired comprehension. In gathering evidence of understanding, educators should consider various assessment methods such as project tasks and other evidence. Project assignments demand learners to apply learning in authentic situations to

assess knowledge and the ability to transfer it. In addition, exams, quizzes, observations, and portfolios are utilised as additional evidence in assessments so that teachers may determine what students know and what needs to be done. In this step, peer evaluation is highly advised since students are permitted to participate in both peer and self-assessments to assist them in determining whether their work is up to par.

Stage 3. Planning Learning

In traditional learning design, planning is typically the starting point. However, in Understanding by Design (UbD), it is regarded as the final step. For this reason, it is called backward design. There are several key questions to consider regarding backward design (Wiggins & McTighe, 2005): What kind of knowledge (facts, concepts, and principles) and skills (procedures) do learners need to perform effectively and achieve desired outcomes? What activities will equip learners with the required knowledge and skills? What needs to be taught and trained, and how should it be taught based on performance objectives? What materials and resources are best suited to achieve this goal? Is the overall design coherent and effective?

Planning learning involves making choices about instructional methods, the order of lessons, and the materials used to achieve the desired outcomes. Teaching is a means to an end, and having clear goals allows educators to focus on their planning and take purposeful actions to reach those outcomes. To teach for understanding, learners must be given sufficient opportunities to draw their conclusions and make generalizations with the guidance of educators (Wiggins & McTighe, 2012). Comprehension is not only demonstrated by providing explanation but students must be fully immersed in meaning construction. Transfer learning is about applying learning to new situations and environments and receiving timely feedback on student projects. In this Understanding by Design (UbD) framework, educators are not the only sources but also facilitators of meaning-making and trainers who provide feedback and suggestions on effective content.

PROCESS, RESULTS AND DISCUSSION

The process and Results of developing a Problem-Based Learning Model with a Teaching at the Right Level (Tarl) Approach using the Understanding by Design (UbD) method are as follows.

Stage 1. Identification of Target Outcomes

At this point, learning challenges are identified based on firsthand experience as an educator. The target results are detailed in terms of problem types, identified issues, and an analysis of these problems, as shown in Table 1.

Table 1 Identify the Problem

No.	Types of Problems	Issues Identified	Problem Identification Analysis
1	Building Relationships with Students	1. Learners are less active in group discussions	a. Learners feel insecure to speak in groups. b. Learners do not understand the values obtained from discussion c. Learners do not understand the material being discussed. There are learners who are too vocal in their group so that others do not need to participate in discussions. d. Educators lack sufficient support to encourage student participation in discussions. e. Questions asked by educators have not been able to stimulate thinking or have not attracted enough attention for students to respond actively f. Educators have not optimally understood students' learning styles.
2	Assessment	1. Educators have not conducted Assessment for learning and assessment as learning in their learning at the classroom.	a. Educators do not understand the process of implementing assessment for learning and assessment as learning b. Educators do not understand the function and purpose of assessment c. Educators do not understand the purpose of assessment, the purpose of providing assessment is to improve feedback on the learning process of students, monitor learning progress and determine student learning progress.
		2. Lack of awareness of learners regarding the purpose and benefits of assessment as learning so as not to take the initiative to engage in this process.	a. Students do not have adequate information about the concept and purpose of assessment as learning. b. Students have not been involved in planning and arranging assessments that are appropriate to learning. c. Learners lack the understanding that assessment is a tool that can help them understand how far they have achieved learning objectives. d. Educators have not conveyed the benefits and objectives of assessment as learning to students.
		3. Educators have not designed assessment as learning rubrics	a. Educators do not fully understand the importance of assessment as learning to observestudents'progress. b. Educators lack understanding in designing assessment formats as learning that are appropriate in the learning process c. The current assessment process has been primarily concentrated on a single aspect. d. Traditional assessments based on learning outcomes are still commonly used by educators.
3	Utilization of technology in learning	Educators currently lack sufficient digital literacy to effectively utilize learning	a. Slow internet access or inadequate wifi connection. b. The substantial budget required for internet

		tools	access has not yet been fulfilled c. The class layout is far from internet access. d. The management of internet access is not optimal.
		2. Educators currently lack sufficient digital literacy to effectively utilize learning tools	a. Educators do not possess sufficient information to integrate technological tools in learning, because of rapid technological developments, making it difficult for educators to stay current with the latest developments, as well as adapt learning to relevant technology. b. Not all educators have equal access to knowledge resources or tools. c. Educators lack of confidence to use technology in learning. d. Education units have not provided sufficient support for the use of technology in learning
		3. Learners frequently employ technology for non-educational purposes.	a. Learners struggle to use technology effectively. b. Learners demonstrate a disproportionate usage of time when it comes to technology, with a tendency to spend more time on games rather than educational purposes c. Students are not aware on the negative impact of technology in learning. d. High dependence of learners on technology for games rather than learning. e. Educators have not provided adequate understanding for the effective use of technology.
4	HOTS (High Order Thinking Skills) Material	1. Students have difficulty in solving contextual problems.	a. Learners do not possess a fundamental concept relevantfor solving problems within specific contexts. b. Students do not have the ability to identify problems, plan solutions and evaluate possible solutions in contextual problem solving. c. Students seldom engage in resolving problems that require contextual problem-solving skills. d. Educators rarely provide problems in the form of contextual problem solving e. Educators are concerned about the students' potential failure to solve contextual problem. f. Inadequate guidance for teachers and students to solve contextual problem.
		2. The assessment system is still focused on knowledge rather than problem-solving skills.	a. Exams or assessments used in learning are only designed to assess knowledge, while problem-solving skills are often overlooked. b. Assessments often focus on standardized test results that measure knowledge rather than problem-solving ability.
5	Motivation problems	1. Students have faced challenges in delivering high-quality presentations.	a. Students frequently experience a sense of insecurity during presentations, stemming from feelings of embarrassment and perceived incompetence..

			b. Students lack sufficient skills in delivering their presentation, for example the ability to speak in front of the class. c. Students are less interested in the topic or material to be delivered. d. Lack of support and encouragement from educators about the benefits and purpose of presentations.
		2. Educators have not maximally applied the rules in the implementation of presentations.	a. Educators consider the rules in the presentation to be less important. b. Educators lack understanding of how to apply effective rules in presentations c. Educators have not been able to prepare a good classroom for presentations.

Source: Results of Analysis of Educator and Co-Educator Problems in the Learning Environment.

Explore the Causes of the Problem

The fundamental concept of this activity involves the identification of previously assessed issues. During the exploration phase, the focus is on formulating the problems to be addressed, identifying their causes, selecting solutions, and outlining their descriptions, advantages, disadvantages, and mitigation plans for any weaknesses. This is based on a thorough literature review, observations, and interviews. The outcome of this process is as follows.

1. The chosen issue to be addressed, based on problem identification and exploration of its causes, is the students' limited ability to comprehend mathematical concepts in the area of mathematical sequences.
2. Causes of the Problem; a. Ineffective application of innovative learning models, b. Educators do not have sufficient references for using learning media, c. Educators are challenged to integrate learning media with learning materials, d. Educators conduct diagnostic tests only at the beginning of the semester to reflect on the prior learning level, e. Difficulties faced by teachers in identifying contextual situations relevant to learning material. Educators do not sufficiently motivate students during the learning process.

3. Selected Solution

   The strategies adopted to address the identified problems and achieve the learning objectives in this study are as follows: a. Implementation of the Problem-Based Learning (PBL) model, incorporating the Teaching at the Right Level (TaRL) approach within the PBL framework, b. Employment of various learning media, c. Development of instructional materials utilizing the Canva application, d. Design of student worksheets (LKPD) using the Canva application along with giving reward.
4. Description; Relating to the problem of the low ability of students to understand mathematical concepts in arithmetic row material and its causes, the solution to overcome it is to apply the Problem Based Learning learning model with the Teaching at The Right Level (TaRL) approach in mathematics learning. Integrating the Teaching at The Right Level (TaRL) approach into the PBL learning model, because the Teaching at The Right Level (TaRL) approach refers to the level of achievement or ability of students. This

approach is also a form of implementation following the philosophy of Ki Hajar Dewantara Education which pays attention to the achievements, levels of abilities and students' needs as a reference for designing learning. The Teaching at The Right Level (TaRL) approach is conducted as follows:

a. Determine learning methods such as discussion, question and answer and presentation methods.
b. Using video teaching materials, textbooks, or gadgets.
c. Using learning media designed with the Canva application
d. Determine learning scenarios according to time allocation as explained below:
    1) Step 1; initially, students are assessed on their reading abilities through activities such as showing videos and distributing teaching materials
    2) Step 2; Organize students into groups based on their ability levels: high, medium, and low.
    3) Step 3; Facilitate group discussions and administer tailored treatments to each group, use specifically prepared LKPD materials for each group.
    4) Step 4; Each group presents their work to the class. Upon completing their presentations, all participants receive rewards such as candy, with the most active participants receiving additional prizes like pens or notebooks.
    5) Step 5; Evaluate
    6) Step 6; Prompt students to express their thoughts and ideas by writing on paper as they engage in learning.

5. Advantage

a. Advantages of the Teaching at The Right Level (TaRL) Approach; 1) Firstly, it simplifies the process for educators to customise learning materials based on students' interests and abilities.2) Assist educators in developing robust conceptual frameworks and enhancing learners' cognitive abilities.3) Facilitate learners' active engagement in the learning process through increased interactivity. 4) This aligns with Margaretha Herlin's (2023) assertion regarding the significance of the TaRL approach in enhancing learners' literacy and numeracy skills.

b. The advantages of using the Canva App are as follows; 1) Enables the creation of designs that match individual preferences and requirements. 2) Offers a wide range of templates to choose from. 3) Is easily accessible and user-friendly. Source: Miftahul Jannah, 2020. Use of Canva Application in Mathematics Learning Media in Elementary Schools

c. The benefits of incorporating rewards into the learning process included: 1.Significantly impacting students' motivation to engage in positive behavior. 2. Inspiring other students to act positively upon witnessing their peers receive rewards. Source: Sinta Devi Widi Astuti, 2017. The Effect of Giving Rewards on the Learning Outcomes of Class VIII Students in Fiqh at MTs Negeri 2 East Lampung.

6. Solutions' Limitations

a. The Teaching at the Right Level (TaRL) Approach: 1) Implementing this method requires a considerable amount of time for both preparing and customizing the materials to match the learners' abilities. 2)This approach demands a higher level of educator involvement to assess learners' progress. Source: Margaretha Herlin, 2023. The Importance of TaRL Approach to Improve Literacy and Numeracy.

b. Using the Canva App; 1. An internet connection is necessary to use the app. 2. Some templates, stickers, and illustrations require payment. Source: Miftahul Jannah, 2020. Use of Canva Application in Mathematics Learning Media in Elementary Schools.

c. Reward; 1.Excessive rewards can lead to negative consequences 2. Occasionally, providing rewards can be costly
Source : Sinta Devi Widi Astuti, 2017. The Effect of Giving Rewards on the Learning Outcomes of Class VIII Students in Fiqh MTs Negeri 2 East Lampung.

7. Measures for Improvement; These are actions taken to address the shortcomings of the proposed solutions, including: a. Enhancing the TaRL learning approach; Implementing time allocation strategies for assessment, b. Improving Canva App usage; Converting content to PowerPoint format using a free application, c. Refining Reward Systems; Issuing straightforward rewards at reasonable costs

Drafting an Action Plan: The activities involved in the planning phase of an action plan revolve around developing educational tools that emphasize three primary components: objectives, assessment evidence, and learning activities, including formative assessment. This design is based on the backward design concept within Understanding by Design (UbD). The outcomes of implementing this action plan are as follows.

Learning Outcomes (CP): The curriculum outlines specific learning outcomes as follows: By the end of phase E, students should be able to generalize the properties of rank numbers, including fractional power numbers. They should demonstrate proficiency in applying arithmetic and geometric progressions, including solving problems related to simple interest and compound interest.

Teaching Process Learning Objectives (TP): Following the Problem-Based Learning Model with the Teaching at The Right Level (TaRL) approach, students are expected to master the concept of arithmetic progressions with accuracy and enthusiasm.

Assessment Evidence

The assessment strategy employed by educators to measure learning objectives and/or mathematics learning outcomes in this study consists of:

1. Assessment For Learning:
a. Observational assessment during group discussions using observation sheets.
b. Evaluation of group discussion outcomes through group worksheets.
c. Individual assessments via quizzes created by educators.

2. Assessment As Learning:
a. Peer assessment where students exchange answers for examination.
b. Learning activities integrated with formative assessment.

Result

Following a thorough and comprehensive analysis, the solution determination activity has been incorporated into the chosen learning model, which is the Problem-Based Learning Model combined with the Teaching at the Right Level (TaRL) Approach. The syntax design and activities carried out in the learning process include:

Introduction

1. Orientation
   a. The educator began the session with a greeting, followed by the class leader leading the students in a group prayer to start the learning.
   b. Educators check student attendance.
2. Apperception
   a. Educators guide students to recall the material of two-variable linear equation systems as prerequisite material for rows and arithmetic series.
   b. Educators explain learning objectives to students.
3. Motivation
   a. Educators explain the practical applications of learning about arithmetic sequences and series in everyday life, such as in economics and science.
   b. Orienting learners to problems (Syntax 1 PBL)

      The implications of the TaRL Approach in learning include: 1) Educators present videos and distribute LKPDs with varying levels of complexity, along with basic teaching materials that support the concept of arithmetic sequences, utilizing gadgets to enhance students' literacy and numeracy skills, 2) Students observe and analyze the problems presented in the video

Core Activities

The core activities in this learning process are:

1. Organizing learners to learn (Syntax 2 PBL)
   a. Prior to the learning process, educators classify students into three groups—high, medium, and low—according to their cognitive abilities, as identified from the results of the diagnostic test analysis.
   b. Educators instruct learners to sit in their assigned groups
2. Guiding learners, both on an individual basis and in group settings. (Syntax 3 PBL)
   a. Students participate in group discussions based on their cognitive levels as assessed in the previous diagnostic test. Each group receives tailored instruction; for instance, groups with medium and high abilities are provided with Learning Tools of Problem Solving (LKPD) focused on analysis and evaluation tasks. The low-performing group receives Learning Tools of Problem Solving (LKPD) focused on the application level of problems.

b. Educators started visiting each group to understand students' challenges better and document the activities students were engaged in within their groups
c. Educators motivate students to actively participate in discussions.
d. Prior to the start of learning, educators complete observation sheets that have been prepared in advance.
e. Educators acknowledge and praise students for their positive actions and accomplishment

3. Assisting students to develop and present their work. (Syntax 4 PBL)
a. Upon completing all activities in the Group Worksheet, the educator guides each group to review their work collectively before presenting it to the class.
b. Students capture photos of their discussion outcomes documented in the Group Worksheet and forward them to the educator via WhatsApp for showcasing during the presentation.
c. The educator assigns the group representative to deliver the discussion outcomes in front of the class.
d. The educator and other groups actively listen to the students' presentations.

4. Assist learners to analyze and evaluate the problem-solving process. (Syntax 5 PBL)
a. Other group members' attention is directed towards the presentation, and they are encouraged to ask questions and provide critical and communicative responses.
b. Drawing conclusions from the material presented, learners, under the educator's guidance, analyze the presentation delivered by the group representative.

Final Activities
Guiding learners to analyze and evaluate the problem-solving process (Syntax 5 PBL) through the following activities:
1. Educators ask students to take quizzes given individually, where the questions are displayed in teaching materials.
2. Educators request students to jot down their reflections and thoughts regarding the learning process. They ask students to:
   a. Summarize briefly the intriguing aspects of the learning process.
   b. Summarize briefly the less captivating aspects of the learning process.
   c. Share their overall thoughts on the conducted learning experience.3. The educator delivers the next learning material and has the learners read and summarize it for the next meeting.
3. The educator and the learners end the learning process by saying Hamdalah.
4. The educator delivered the closing greeting.

What kind of specific actions do educators (and learners) take to identify obstacles that students face and track their progress towards achieving goals?
a. Educators give feedback to students by reinforcing accurate concepts and correcting any misconceptions.
b. Educators instruct students to reflect on the learning process by writing responses on paper based on questions provided by the educators as follows:

1) What concepts have you understood in today's learning?
2) What concepts do you not understand in today's learning?
3) What difficulties do you face to understand the concept of arithmetic rows?

Research Outcome of Innovative Model Development

1. Learning Model Development Results

The outcomes of implementing the PBL Learning Model integrated with the Teaching At The Right Level (Tarl) Approach for Arithmetic Progressions are presented in Table 2.

Table 2 Results of Problem-Based Learning Model Development with Teaching At The Right Level (Tarl) Approach on the Subject of Arithmetic Rows.

Learning Activities	Time Allocation
Introductory Activities	
1. Orientation b. The educator began the session with a greeting, followed by the class leader leading the students in a group prayer to start the learning. c. Educators check student attendance. 2. Apperception ;Educators guide students to recall the material of two-variable linear equation systems as prerequisite material for rows and arithmetic series. 3.Provide Igniting Questions 3. Which of you can name an odd number? 4. What is the difference between the odd numbers 5. What is the difference between the odd number pattern and the even number pattern (is it constant or not) 4.Meaningful Understanding; By delving into the content related to arithmetic progressions and series, you gain the ability to utilize these concepts in real-life scenarios, such as in economics, social contexts, and other relevant areas 5.Giving motivation; a.Educators convey learning objectives to students., b.Educators convey the benefits of studying arithmetic sequences and series in everyday life, such as: in the field of economics and in the field of science 6.Orienting Students to Problems (Syntax I PBL) Due to its adoption of the Teaching at the Right Level (TaRL) methodology, the conducted activities are as follows:: 7. Educators employ a range of strategies, including video presentations, the distribution of worksheets with varying difficulty levels (LKPD), and the provision of supporting materials that reinforce the understanding of arithmetic sequences. They also integrate the use of electronic devices like smartphones to enhance students' literacy and numeracy abilities. (https://www.youtube.com/watch?v=zU19I3OMkaw.) 8. Students observe the issues in the video displayed.	15
Core Activities Organizing students to learn (Syntax 2 PBL); a. Prior to the learning process, educators classify students into three groups—high, medium, and low—according to their cognitive abilities, as identified from the results of the diagnostic test analysis. b. Educators instruct learners to sit in their assigned groups Guiding students both individually and in groups (Syntax 3 PBL) a. Students participate in group discussions based on their cognitive levels as assessed in the previous diagnostic test. Each group receives tailored instruction; for instance, groups	45

with medium and high abilities are provided with Learning Tools of Problem Solving (LKPD) focused on analysis and evaluation tasks. The low-performing group receives Learning Tools of Problem Solving (LKPD) focused on the application level of problems. b. Educators started visiting each group to understand students' challenges better and document the activities students were engaged in within their groups c. Educators motivate students to actively participate in discussions. d. Prior to the start of learning, educators complete observation sheets that have been prepared in advance. e. Educators acknowledge and praise students for their positive actions and accomplishment Assisting students to develop and present their work (Syntax 4 PBL) a. Once students finish all tasks on the Group Worksheet, the educator directs each group to review their collective work before sharing it with the class. b. Students capture images of their Group Worksheet discussions and send them to the teacher via WhatsApp for display during the presentation. c. The teacher invites representatives from each group to present their discussion outcomes to the class. d. Educators and other groups attentively listen to the explanations provided by the presenting students. Helping students analyze and evaluate the problem solving process (Syntax 5 PBL) a. Other group members attentively observe and are given a chance to pose questions and provide critical and communicative responses to the presentation made by the presenting group. b. Using the presentations delivered by the group representatives, students, under the guidance of educators, derive conclusions regarding the presented material.	
CLOSING ACTIVITIES Guiding learners to analyze and evaluate the problem-solving process (Syntax 5 PBL) through the following activities: 1. Educators ask students to take quizzes given individually, where the questions are displayed in teaching materials. 2. Educators request students to jot down their reflections and thoughts regarding the learning process. They ask students to: a. Summarize briefly the intriguing aspects of the learning process. b. Summarize briefly the less captivating aspects of the learning process. c. Share their overall thoughts on the conducted learning experience. 3. The educator delivers the next learning material and has the learners read and summarize it for the next meeting.	20
Total amount of time required 2 JP(Learning hours)	80

2. Assessment Results

a. Assessment for Learning

The assessment results indicate a steady improvement in the completeness of learning outcomes throughout the learning process. Starting at 90% in the pre-cycle phase, the implementation of the ARCS (Attention, Relevance, Confidence, Satisfaction) Integrated Problem Based Learning model in cycle 1 led to a 95% completeness level. This was maintained at 95% in cycle 2, involving the Problem-Based Learning model with the Teaching at The Right Level (TaRL) approach. These results suggest that the general learning objectives have been successfully achieved. This finding is consistent with previous research by Giri Wahyu Pambudi (2019), which highlighted the effectiveness of the Problem-Based Learning model in enhancing students' understanding of concepts and motivation. Similarly, Anugraheni's study in 2018 also emphasized the positive impact of Problem-Based Learning on improving students' comprehension of mathematical concepts, leading to improved learning outcomes.

Students derive several benefits from assessment activities for learning, including a. Understanding their strengths and weaknesses in completing individual or group-based assignments like quizzes. b. Enhancing their understanding of the learning material and its applicability to real-life situations. c. Developing critical thinking skills. d. Boosting motivation through active participation in the learning process. e. Clarifying their grasp of conveyed learning objectives. f. Promoting awareness about the importance of learning mathematics.

In implementing assessment for learning, there are several challenges when assessment activities take place, and these challenges are as follows: a. Group discussion ; The challenge experienced during group discussions was to activate all students because during the learning process, there were still 2 students who were not yet maximally active. Apart from that, this also happened when presenting the results of group discussions, where group 4 had to be asked repeatedly to present the results of their discussions. b. Individual Assessment (Quiz); The challenge experienced when assessing individual assignments or taking quizzes is ensuring that students do not look or copy from other students.

During the implementation of assessment for learning, certain challenges arise in assessment activities:

a. Group Discussions: One challenge faced during group discussions was ensuring active participation from all students, as two students were not fully engaged during the learning process. This issue also extended to the presentation of group discussion outcomes, as Group 4 needed to repeat prompting to present their discussions.

b. Individual Assessment (Quiz): Another challenge encountered during individual assessments or quizzes was preventing students from cheating or copying from their peers.

b. Assessment as Learning

The assessment outcomes in the form of reflections on the learning journey and students' self-assessments indicate a positive reception. This is evident from the responses recorded on the reflection sheets, where students generally express satisfaction with the

applied learning model. Through the implementation process of this learning model, several benefits arise from assessment as learning:

a. Facilitating students in reflecting on their conceptual understanding of the studied material.
b. Cultivating self-assessment skills in students.
c. Encouraging students to take greater responsibility for their learning process.
d. Nurturing students to become more independent in their learning.
e. Boosting students' self-confidence.

The challenges encountered in conducting assessment as learning are:

a. Teachers haven't effectively guided students in performing self-assessments.
b. Teachers haven't provided clear guidelines for student self-assessments.
c. The need to elaborate and clarify questions on the reflection sheet.

Overall, the assessment conducted during the learning process encompasses a comprehensive evaluation that includes various aspects such as the topic or learning material, knowledge, skills, surveys, or reflection sheets, and literature review. Additionally, the assessment tools employed, such as group worksheets, individual worksheets, and reflection sheets, have been designed to evaluate students' comprehension of material concepts and provide a fair and accurate assessment aligned with the established learning objectives.

Discussion

In developing the Problem-Based Learning (PBL) Model with the Teaching at The Right Level (TaRL) approach, it is necessary to carry out a reflective analysis. Reflective analysis was conducted on the trial implementation of the developed innovative learning model. This analysis connects successful aspects and ongoing challenges during the learning process to theoretical insights gained through exploration, aiming to identify potential solutions.

The process of reflection activities from the Problem-Based Learning (PBL) Model with the Teaching at The Right Level (TaRL) Approach is as follows.

Reflection Activities

1. Topic: Arithmetic Sequences
2. Learning Objectives

   After engaging in the learning process utilizing the Problem-Based Learning (PBL) Model and the Teaching at The Right Level (TaRL) Approach, students show improved critical thinking skills. Theycan apply the concept of arithmetic sequences with precision and accuracy.
3. Innovations carried out

   a. Learning Activities prior to the implementation of the Problem-Based Learning (PBL) Model with the Teaching at The Right Level (TaRL) Approach

   Before implementing the innovative learning model, the classroom learning process was predominantly conventional, using the lecture method. Learning activities primarily include transmitting knowledge from educators to students rather than engaging students

in active learning. Student participation was mainly limited to completing exercises or assignments the teacher gave. This method led to students' preference for lessons fully explained by the teacher from beginning to end rather than encouraging them to solve mathematical problems independently before the material was taught. Consequently, a substantial cohort of students perceived mathematics as a challenging discipline and lacked enthusiasm for studying it. This aligns with Yurike Susan Sumendap's (2022: 303) observation that conventional learning typically focuses on rote memorization of material provided by the teacher without connecting the content to current or relevant contexts.

b. Learning activities after implementing the Problem-Based Learning (PBL) Model with the Teaching at The Right Level (TaRL) Approach

With the introduction of the new learning model, classroom activities now employ an innovative approach known as the Problem-Based Learning (PBL) Model, combined with the Teaching at the Right Level (TaRL) Approach. The learning process follows the PBL model syntax as described by Arends (2008) and Triyono (2020). This involves orienting students to problems, organizing them for learning, guiding their investigations individually and in groups, helping them develop and present their work, and analyzing and evaluating the problem-solving process.

The Problem-Based Learning (PBL) methodology is employed due to its capacity to enhance students' aptitude in applying the notion of arithmetic sequences to contextual situations within the realm of science. This aligns with the viewpoint of Rizema (2013:69) and Aklimawati, et al. (2019) who assert that utilizing the Problem Based Learning (PBL) Model is highly beneficial for teaching arithmetic sequences and series. This approach involves students engaging with real-world problems to construct their own understanding, foster inquiry and critical thinking skills, and ultimately achieve the learning objectives that are integrated with the problems. Problem Based Learning (PBL) is an educational approach that involves a series of tasks aimed at fostering students' independence and equipping them with the skills to effectively tackle various challenges they may encounter in their lives.

In addition to the Problem-Based Learning (PBL) model, the Teaching at the Right Level (TaRL) approach is also implemented. Before this approach is applied, an initial diagnostic test consists of questions about the prerequisite material for arithmetic sequences is conducted. The test results are used to assess prerequisite skills and to group students according to their cognitive abilities. This approach includes content differentiation for students with varying ability levels: high and medium-ability students receive similar problems, while low-ability students are given different problems. Analysis of student scores indicates that the TaRL approach with content differentiation improves student learning outcomes. This finding is consistent with Veronika PriellaMangesthi et al. (2023), who noted that implementing the TaRL approach in learning can enhance student performance.

The group discussion method is chosen in applying the Problem-Based Learning (PBL) model combined with the Teaching at the Right Level (TaRL) approach. This method allows observation of students' collaboration abilities, effectively completing group tasks, and presenting their group work. This approach aligns with the research findings of Nasihudin

Pono et al. and Abuddin Nata &Sudarman (2018), which indicate that the discussion method enhances students' collaborative skills, problem-solving abilities, and overall learning outcomes.

According to the previous statement, implementing the Problem Based Learning (PBL) model along with the Teaching at The Right Level (TaRL) approach and the group discussion method yields highly satisfactory outcomes. These outcomes are evident in the students' active participation during the learning process, their comprehension of the studied concepts, and their notably positive learning achievements. In addition, students who have displayed lower levels of engagement in their studies experience a surge of enthusiasm as they receive tailored interventions that align with their cognitive capacities.

Another innovative method implemented is the integration of technology in the core learning activity, specifically using learning videos. This approach aims to enhance students' focus on the study content. Nova Eli Herani (in Tasya Kesaulya, et al, 2023) demonstrated that using instructional videos is efficacious in facilitating the learning process, particularly in captivating students' attention and enhancing their concentration to comprehend and assimilate the instructional content. After viewing videos related to arithmetic sequences, students are assigned to complete the LKPD associated with the content of the video. This approach has significantly boosted students' motivation to learn. During discussions, the educator offers support to each group based on their findings. When a group poses questions, the educator assists them by posing further questions to enhance and refine their cognitive abilities. Subsequently, the outcomes of the group discussion are presented in the class to assess the student's proficiency in articulating ideas or viewpoints in a public setting. According to Luritawaty (2019), communication is the act of transmitting information that has been organized by the sender, with the goal of ensuring that the recipient comprehends the intended meaning.

The learning innovations that were carried out also occurred in the closing activities, where educators reflected on the learning process and carried out self-assessments which were provided in the students' worksheets in the form of open questions. This is done to determine the success of the learning carried out. This is in line with what Rizky Nurmeida Sobari (2014) stated that to find out the success of the learning process is to ask for feedback from students. The learning innovations extended to the closing activities, where educators reflected on the learning process and conducted self-assessments provided in the students' worksheets as open-ended questions. This approach is used to gauge the success of the learning activities. In a similar vein, Rizky Nurmeida Sobari's (2014) highlights that obtaining feedback from students is essential for evaluating the effectiveness of the learning process

4. Reasons for choosing learning innovation

The Problem-Based Learning model incorporating the Teaching at the Right Level (TaRL) approach and group discussion was chosen as a learning innovation because it allows educators to tailor learning to students' cognitive capacities, optimize learning based on their requirements, and adapt to technological advancements. Moreover, it enhances students' comprehension of concepts and problem-solving skills, as well as fosters the development of

social skills like collaboration, critical thinking, confident expression of opinions, and articulation of ideas.

5. Benefits of Learning Innovation for Educators

a. Improved Achievement of Learning Objectives: Learning innovations lead to better attainment of learning objectives. For instance, in cycle 1, students with lower cognitive abilities struggled to apply concepts, but in cycle 2, almost all of them succeeded in applying these concepts.

b. Enhanced Educator Motivation: Educators' motivation and enthusiasm increase when implementing learning innovations. Adopting new and challenging methods keeps educators engaged and brings a sense of novelty to their teaching.

c. Boosted Educator Creativity: Learning innovations foster educator creativity in designing engaging learning materials that enhance student understanding of the subject matter.

d. Increased Collaboration: Learning innovations promote collaboration among educators, allowing them to gain diverse perspectives and insights, ultimately benefiting teaching practices.

e. Updated Learning Content: Educators can continuously update and enhance learning content through innovations, ensuring students receive the latest information.

f. Improved Teaching Efficiency: Learning innovations enable educators to manage tasks efficiently, such as assessments and tracking student progress, allowing them to focus more on core teaching and deepening students' understanding.

Overall, motivated, creative, and informed educators are better equipped to provide enriching learning experiences for students.

6. Positive Effects of Innovative Learning on Students

The notable advantage is that students' learning outcomes exhibit significant improvement compared to the previous learning procedure. During the learning process, 5 out of 6 pupils achieved the highest possible score (100), indicating successful implementation of content differentiation. In addition to the enhanced learning outcomes, other positive findings were discovered.

a. Students exhibit increased levels of engagement.

b. Students experience a greater sense of participation in the learning process, such as through conversations or in-depth exploration of the topic, leading to improved comprehension due to their active involvement in learning.

c. Collaborative skills improve.

d. Learning innovation can foster collaboration among students, enabling them to engage in group work to solve challenges, so promoting cooperation among students.

e. The ability to study independently; Learning innovation enables students to take responsibility for managing their time, accessing resources, and seeking a deeper knowledge of the content.

f. Student motivation is enhanced when engaging learning approaches are employed, leading to increased desire to study and improved academic performance.

g. Deeper understanding of concepts :Active involvement in learning enables pupils to develop a more profound comprehension of subjects, allowing them to establish connections with bigger ideas.

The findings of this study is consistent with the research outcomes of Indrawati (2014) in Arlin Yuniyanti, et al, (2023). Specifically, the advantages of implementing the Problem Based Learning Model with the TaRL Approach include its relevance to students' lives, alignment with students' needs, promotion of problem-solving skills, enhanced comprehension of the studied concepts, and improved learning outcomes.

7. Challenges in Implementing PBL withTarLand Group Discussion

The implementation of learning innovations encounters several significant challenges:

a. Limited internet access, which is available only in some classrooms, hinders the implementation of learning innovations.

b. Educators experience difficulties in identifying or designing contextual problems that align with students' comprehension levels.

c. Accurately assessing students' understanding remains problematic, as some students still engage in academic dishonesty during individual assignments (quizzes).

d. Insufficient time hampers educators' ability to implement learning models to their full potential.

e. Students exhibit reluctance towards transitioning from traditional learning methods to new models that necessitate problem-solving through group discussions.

f. Ensuring active participation from all students during group discussions is challenging, with some students remaining passive.

g. Fostering students' motivation and self-confidence to present group discussion outcomes proves difficult.

h. Effective assessment, particularly assessment as learning, is not yet optimized due to the lack of student involvement in designing assessment rubrics, such as self-assessments and peer assessments.

Thus, it is imperative to design learning innovations with careful consideration of the material's characteristics, student needs, and the availability of resources and training required to support the effective implementation of these innovations.

8. **Addressing Challenges in Learning Innovations**

Solutions to Address Challenges in Implementing Learning Innovations:

a. To resolve internet access issues, seek permission from the facilities and curriculum representatives to use classrooms with internet access, and consider using personal hotspots.

b. Utilize contextual problems from YouTube and adapt them to match students' cognitive levels.

c. Address cheating by calling out the student's name and motivating them to practice honesty, reinforcing the Pancasila student profile.

d. Maximize time during the learning process by reminding students about time limits, especially during group discussions or quizzes.

e. Educators should motivate students by highlighting the benefits and advantages of the new learning model being implemented.

f. Address inactive participation by calling out the student's name and providing individual attention.

9. Follow-UpPlansforSuccessfulLearningInnovation

To ensure the smooth implementation of learning innovation, the following follow-up plans should be executed:

a. Notify the head department for Facilities and Infrastructure and the Curriculum to ensure that all classes have an internet connection.

b. Perform diagnostic tests for every new material to be examined, c. Developing a literacy program, such as familiarizing pupils with reading textbooks and utilizing technology, as well as creating summaries prior to studying educational material.

d. Participate in training or workshops to acquire the skills necessary to create contextual questions that are appropriate for students' cognitive capacities.

e. Increase the number of references on learning models that integrate with the Teaching at the Right Level (TaRL) approach

f. Optimize lesson design with a focus on efficient time management.

g. Foster collaboration with educational communities such as MGMP or colleagues, and even students, to regularly innovate and share ideas through discussion groups.

Likewise, in terms of the benefits experienced by students through assessment activities,research findings support the notion that assessment for learning offers advantages such as helping students understand their abilities and their progress towards learning goals, enhancing literacy skills, and improving conceptual understanding of the material (Budiyono, 2015:158; Tabun, H. M., Taneo, P. N. L., & Daniel, F., 2020; Black et al., 2004; Ohlsen, 2007). However, the implementation of assessment for learning is accompanied by several

challenges during assessment activities. During group discussions, for instance, ensuring full participation from all students can be difficult, as some may not engage as actively as others. Similarly, challenges arise during the presentation of group discussion outcomes, where certain groups may need repeated prompting to present their findings. Individual assessments, such as quizzes, also pose challenges in preventing cheating or copying among students.

The result of assessment as learning, particularly through reflections on the learning process and students' self-assessments, demonstrates a positive response based on students' responses recorded in reflection sheets. Generally, students express satisfaction with the applied learning model. M.A. Halim et al. (2020) underscore the pivotal role of self-assessment in fostering independent learning, enabling individuals to gauge their abilities and motivating them to enhance their study efforts. Similarly, as noted by Ramlawati, Yunus, S. R., &Insani, A. (2017) and Sumarno (2011) (cited in NurwatiDjam'an et al., 2017), self-assessment boosts students' motivation and self-confidence deepens their understanding of personal strengths and weaknesses andinstils a habit of honesty in their assessments.

Through the implementation of the learning model, several benefits can be derived from assessment as learning, including:

a. Facilitating students' reflection on their understanding of the material studied.
b. Developing students' skills as self-assessors.
c. Encouraging students to take responsibility for their own learning process.
d. Fostering independence in students' learning.
e. Enhancing students' self-confidence.

These findings are supported by research findings such as those of Santari (2015), which highlight that assessment as learning, particularly self-assessment, can improve students' comprehension of mathematical concepts. Similarly, research by Rolheiser and Ross (2001), as cited in NurwatiDjam'an (2017), underscores that assessment as learning through self-assessment can boost students' self-confidence.

However, implementing assessment as learning presents several challenges:

a. Educators may not effectively guide students in conducting self-assessments.
b. Clear guidelines for students to conduct self-assessments may not be optimally provided by educators.
c. Questions on reflection sheets may need to be expanded and clarified.

Generally, the assessment conducted throughout the learning process constitutes a holistic evaluation that encompasses various aspects including the topic or learning content, knowledge, skills, surveys or reflection sheets, and literature reviews. Moreover, the assessment tools used, such as group worksheets, individual worksheets, and reflection sheets, are designed to measure students' understanding of the concepts covered in the material and to provide an equitable and accurate assessment in line with defined learning objectives.

In the implementation of assessment in this study, identified issues such as student participation in discussions and integrity during individual assignments (quizzes) are addressed with specific solutions:

a. Addressing inactive participation by verbally alerting students.
b. Encouraging and motivating students to engage actively in discussions.
c. Promoting a culture of honesty and discouraging cheating during individual assignments (quizzes).

Similarly, in the context of Assessment as learning, solutions include:

a. Providing clear guidance for students to conduct self-assessment.
b. Communicating the purpose and benefits of self-assessment.
c. Ensuring comprehensive support and direction for students in performing self-assessment.

These approaches highlight that the aim of learning extends beyond achieving final outcomes; it encompasses fostering a deep and sustainable understanding through a supportive learning environment that enables students to attain their educational objectives.

CONCLUSION

The development of the Problem-Based Learning (PBL) model integrated with the Teaching At The Right Level (TaRL) approach for teaching arithmetic series follows a method called Understanding by Design (UbD). This process begins with several key activities: 1) identifying learning objectives or specific problems, including pinpointing the issue, exploring its causes, determining the root cause, and proposing solutions. 2) Conducting thorough analysis activities related to assessments and evidence used to achieve learning goals or address student challenges in the learning process. 3) Designing the structure of the PBL model with the TaRL approach. Following these steps, the next phase involves testing the model in a classroom setting, where identified student challenges are addressed through problem-solving activities like those in the initial stages of development.

The research has led to an innovative learning model named the Problem-Based Learning Model with the Teaching at The Right Level (TaRL) approach. The learning process is structured as follows: a. Initial activities involve orientation, apperception, posing trigger questions, fostering meaningful understanding, providing motivation, and applying TPACK to guide students towards problem orientation (Syntax 1 PBL). b. Core activities include organizing student learning (Syntax 2 PBL), guiding students individually and in groups (Syntax 3 PBL), assisting in the development and presentation of student work (Syntax 4 PBL), and facilitating analysis and evaluation of problem-solving processes (Syntax 5 PBL). c. Closing activities involve further analysis and evaluation of the problem-solving process (Syntax 5 PBL). Educators encourage students to reflect on their learning experiences by prompting them with questions to write down their impressions and messages.

Implementing the PBL model with the TaRL approach has yielded positive learning outcomes. There has been an improvement in students' motivation, literacy skills, conceptual understanding, and overall learning achievements. Even students who previously struggled academically have shown significant improvement in their grades in which tailoring the mathematical problems to match students' individual characteristics contributed to this success. However, challenges in implementing this learning approach include limited internet access, difficulty in creating and selecting contextual problems appropriate for students'

comprehension levels, engaging all students actively, enhancing motivation and self-confidence, and conducting effective self-assessments. To address these challenges, the Problem-Based Learning model is employed with the TaRL approach alongside group discussions.

In order to successfully overcome obstacles and problems, the developed learning framework can be implemented sequentially with careful consideration of time allocated for each activity. The activities conducted involve orienting students towards problems, organizing students for learning, providing guidance to students both individually and in groups, assisting students in developing and presenting their work outcomes, and assessing and evaluating the process of problem-solving. Necessary resources and materials for implementing the action plan involve conducting diagnostic assessments to group students appropriately, followed by creating tailored learning materials that suit students' individual characteristics.

References

Abuddin Nata, Sudarman (2018). Analysis Of The Application Of The Discussion Method In Improving Student Learning Outcomes. https://repository.uinjkt.ac.id/ dspace/bitstream / 123456789/36266/1/Elvira%20Rosiana-FITK

Agus Triyono, (2020). Syntax of PBL (Problem Based Learning) According to Experts. https://www.haidunia.com/sintaks-pbl-problem-based-learning/

Ahmad Setyawan (2022). Using the Problem Based Learning Model Improves Mathematics Learning Outcomes on Sequences and Series Material.https://ejournal.undiksha.ac.id/index.php/JLLS/article/view/48460

AkhmadMunaya Rahman, et al, 2022. The Influence of Information Literacy Ability on the Learning Outcomes of Class X Students at SMAN 10 Banjarmasin.https://jurnal.fkip.unmul.ac.id/index.php/geoedusains/article/download/1728/1033

Aklimawati, et al, 2019. Problem Based Learning on Lines and Series Material at SMA Negeri 1 DarulImarah. https://ojs.serambimekkah.ac.id/serambiakademika/article/download/1117/919

Andriani, R. (2018). The Influence of the Problem Based Learning (Pbl) Learning Model on the Science Learning Outcomes of Class V Students at State Elementary School 005 Mount Malelo. Journal of Education and Teaching Review, 1(1), 14–25. https://doi.org/10.31004/jrpp.v1i1.152. DOI: https://doi.org/10.31004/jrpp.v1i1.152

ArlinYuniyantiSilalahi, et al, 2023. Application of Problem Based Learning Methods in Improving Mathematics Learning Results for Class XI Vocational School Students.https://journal.ikipsiliwangi.ac.id/index.php/jpmi/article/view/14021/4232

Darwati, I. M., & Purana, I. M. (2021). Problem Based Learning (PBL): A Learning Model for Developing Students' Critical Thinking. WidyaAccarya, 12(1), 61–69. https://doi.org/10.46650/wa.12.1.1056.61-69. DOI: https://doi.org/10.46650/wa.12.1.1056.61-69

Defiyanti, & Sumarni, W. (2020). Analysis of Critical Thinking Ability After Implementing Problem Based Learning Assisted by Student Worksheets Containing Ethnoscience. Phenomenon: Journal of Mathematics and Natural Sciences Education, 9(2), 206–218. https://doi.org/10.21580/phen.2019.9.2.4200. DOI: https://doi.org/10.21580/phen.2019.9.2.4200

Fatma, A. N., &Budhi, W. (2018). The Influence of the Problem Based Learning Model on Mathematics Learning Achievement. Scientific Journal of Physics Education-COMPTON, 5(December), 23–29. https://doi.org/10.30738/cjipf.v5i1.4141.

Fajar Edi Jatmiko, (2019). Students' Information Literacy Ability and Its Influence on Student Learning Achievement at SMAN 6 South Tangerang City. https://repository.uinjkt.ac.id/dspace/bitstream/123456789/64364/1/FAJAR%20EDI%20JATMIKO%20-%20FAH.pdf.

Fakhrur Rozi Sihombing, (2020). Analysis of Students' Difficulties in Solving Line and Series Story Questions for Class VIII MTs Negeri 1 Padangsidimpuan. http://repository.uinsu.ac.id/14700/1/Fakhrur%20Rozi%20Sihombing%20%2803051622153%29.pdf

Fitri, M., Yuanita, P., &Maimunah, M. (2020). Development of Integrated Mathematics Learning Tools for 21st Century Skills through the Application of the Problem Based Learning (PBL) Model. Gantang Journal, 5(1), 77–85. https://doi.org/10.31629/jg.v5i1.1609. DOI: https://doi.org/10.31629/jg.v5i1.1609

Haryanti, S., & Sari, A. (2019). The Effect of Implementing the Problem Based Instruction Model on Mathematical Problem Solving Ability in terms of the Adversity Quotient of Madrasah Tsanawiyah Students. JURING (Journal for Research in Mathematics Learning), 2(1), 077. DOI: https://doi.org/10.24014/juring.v2i1.6712

Hasanah, U., Sarjono, S., &Hariyadi, A. (2021). The Influence of the Problem Based Learning Model on Social Sciences Learning Achievement at Taruna KedungAdem Middle School. Aksara: Journal of Nonformal Education Science, 7(1), 43. https://doi.org/10.37905/aksara.7.1.43-52.2021. DOI: https://doi.org/10.37905/aksara.7.1.43-52.2021

Hatip, A., & Setiawan, W. (2021). Bruner's Cognitive Theory in Mathematics Learning. Journal of Mathematics Education, 5(2), 87–97. DOI: https://doi.org/10.33087/phi.v5i2.141

HazariGustina,(2020). The Influence of Learning Interest on the Learning Outcomes of Class V Students in Mathematics Subjects in State Elementary School 68 Bengkulu City. http://repository.iainbengkulu.ac.id/5511/1/skripsi%20hazari%20gustina.pdf

Hana Nurul Karimah, et al, (2020). The use of assessment for learning based on only marking on student cognitive learning outcomes. https://onlinejournal.unja.ac.id/biodik/article/download/9578/5864/26811

Herzamzam, D. A. (2018). Increasing Interest In Learning Mathematics Through A Realistic Mathematics Approach (PMR) In Elementary School Students. Visipena Journal, 9(1), 67–80. https://doi.org/10.46244/visipena.v9i1.430.

Herzon, H. H., Budijanto, & Utomo, D. H. (2018). The influence of problem-based learning (PBL) on critical thinking skills. Journal of Education: Theory, Research, and Development, 3(1), 42–46. https://doi.org/10.17977/jptpp.v3i1.10446.

Husain, H., &Syaharuddin, S. (2020). The effectiveness of the application of the Numbered Heads Together (NHT) type cooperative model with a quantum teaching approach in mathematics learning for students of SMP Negeri 1Binamu, Jeneponto Regency. Pedagogy: Journal of Mathematics Education, 5(2), 50–65. https://doi.org/10.30605/pedagogy.v5i2.404.

Huzaimah, P. Z., &Risma, A. (2021). Obstacles experienced by students in online mathematics learning during the COVID-19 pandemic. Journal of Scholars: Journal of Mathematics Education, 05(01), 533–541. https://j-cup.org/index.php/cendekia/article/view/537.

Ika Ayu Puspitasari, et al, (2022). Use of Learning Media in the Problem Based Learning Model in Mathematics Subjects.https://jurnal.fkip.unmul.ac.id/index.php/psnpm/article/download/1248/830

Ina Arisandi Noor (2022). Using Presentation Methods to Increase Student Activeness in Learning Islamic Religion at SMPN 1 Sungai Loban. https://eproceedings.iainpalangkaraya.ac.id/index.php/PPGAI/article/download/244/504

Jihan Auliya, (2018). Application of Self-Assessment to Increase Students' Self-Efficacy in Mathematics Learning. https://ejournal.undiksha.ac.id/index.php/JIPP/article/download/14022/9406/20136

Juliawan, G. A., Putu, L., Mahadewi, P., Rati, N. W., &Tp, J. (2017). The Influence of the Problem Based Learning (Pbl) Model on the Mathematics Problem Solving Ability of Class III Students. Ganesha Education University PGSD E-Journal, 5(2). https://doi.org/10.23887/jjpgsd.v5i2.10881

Larasati, A. (2020). Improving The Quality Of Learning Through Implementation Of The Problem Based Learning Model For Social Interaction. Journal of Religious Education and Training, 18(1), 68–78. https://doi.org/10.52048/innovation.v14i1.202.

Luritawaty, 2019. Mathematical Communication Skills Judging from Self Regulated Learning on Linear Equations in Two Variables. Plusminus. Journal of Mathematics Education.

M.A. Halim, et al, (2020). Development of Self Assessment in Mathematics Subjects at Montesari Elementary School, Bali. https://ejournalpasca.undiksha.ac.id/index.php/jurnal_ep/article/download/3124/1749

Mustaffa, N., Ismail, Z., Tasir, Z., & Said, M. N. H. M. (2016). The Impacts of Implementing Problem-Based Learning (PBL) in Mathematics: A Review of Literature. International Journal of Academic Research in Business and Social Sciences, 6(12), 490–503. https://doi.org/10.6007/ijarbss/v6-i12/2513.
DOI: https://doi.org/10.6007/IJARBSS/v6-i12/2513

Nasahudin Pono, et al. The Effect of Learning Using Group Discussion on Student Learning Achievement on the Subject of Three Dimensional Geometry at MAN Kalimukti, Pabedilan District, Cirebon Regency. https://media.neliti.com/media/publications/55192-ID- Influence-pembelajaran-using-method.pdf

NurwatiDjam'an, et al, (2017). Application of Self Assessment on the Coordinate System Topic on Class VIII Student Learning Outcomes. https://ojs.unm.ac.id/imed/article/download/9251/5357

Ramadhany, A., &Prihatnani, E. (2020). Development of a Social Arithmetic Module Based on Problem Based Learning for Middle School Students. Scholar's Journal: Journal of Mathematics Education, 4(1), 212–226. https://doi.org/10.31004/cendekia.v4i1.155.

Ramlawati, Yunus, S. R., &Insani, A. (2017). The Influence of the PBL (Problem Based Learning) Model on Students' Science Learning Motivation and Outcomes. Sains mat Journal, 6(1), 1–14. https://ojs.unm.ac.id/index/index.

RizkyNurmeidaSobari (2014). Level of Student Satisfaction with Learning Process Services at Averus Vocational. School.

https://repository.uinjkt.ac.id/dspace/bitstream/123456789/25775/1/RIZKY%20NURMEIDA%20SOBARI-FITK.pdf.pdf

Saputri, Y., &Wardani, K. W. (2021). Meta Analysis: Effectiveness of Problem Solving and Problem Based Learning Models in View of Elementary School Mathematics Problem Solving Ability. Scholar's Journal: Journal of Mathematics Education, 5(2), 935–948.
DOI: https://doi.org/10.31004/cendekia.v5i2.577

SetyatiPujiWulandari, Creating Student Learning Independence Through Discovery Learning Based Learning With Assessment For Learning.
https://journal.unnes.ac.id/sju/index.php/prisma/article/download/21475/10159/

Tasya Kesaulya, et al, (2023). Using Learning Videos as an Effort to Increase Learning Concentration for Class VI Elementary School Students.
https://www.ejournal.fkipuki.org/index.php/jdp/article/download/173/66

Vania FrastyaAriesta, (2020). The Influence of Interest on Mathematics Learning Outcomes of Class VII Students at UPT SMP Negeri 1 BatangKapas.
http://repository.unp.ac.id/43872/1/B1_1_VANIA_FRASETYA_ARIESTA_1305594_1044_2022.pdf

Veronika PriellaMangesthi, et al, (2023). The Influence of the Teaching at The Right Level (TaRL) Approach on the Mathematics Learning Outcomes of Class IV B Students at SDN KaranganyarGunung 02.
https://jptam.org/index.php/jptam/article/download/9405/7667/17614

Yurike Susan Sumendap, 2022. Definition of conventional learning and examples.
https://kumparan.com/berita-terkini/pengertian-pembelajaran-konvensional-dan-cepatnya-1zVr4bj3R5b

Observation Results:
https://drive.google.com/file/d/1sW4bwSJ3Ry_4VisJTn0Za1CR-5sQ5IW2/view?usp=sharing

Educator Reflection:
https://drive.google.com/file/d/1xD7PfjFW7qrY94oOh1IxYtSwzRq6axkq/view?usp=sharing

Quiz: https://drive.google.com/file/d/1qm-KxkMF27ccZ9xSCocXWodcY-UX7Q-C/view?usp=sharing

Assignment: https://drive.google.com/file/d/1qm-KxkMF27ccZ9xSCocXWodcY-UX7Q-C/view?usp=sharing

Learner reflection: https://drive.google.com/file/d/1qm-KxkMF27ccZ9xSCocXWodcY-UX7Q-C/view?usp=sharing