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Designing Unifying Instructional, Assessment and Learning through Mathematical Modeling

Bambang Riyanto[1]*
[1]SMKN 1 Sungai Menang, South Sumatra Provincial Education Office, Indonesia
*Corresponding author: risetmodelingbambang@gmail.com

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Abstract

Linking summative and formative assessments to improve the learning process remains an important issue, as there is very few research to address on this topic. The research aims to produce a valid mathematical modeling process student worksheet to integrate instruction, assessment, and learning. This research employed a development research approach, consisting of four stages of the modified ADDIE model: analysis, design, development, and implementation. The analysis step involved analyzing real-world situations, instruction, assessment, learning and the characteristics and principles of applied mathematical modeling problems. The analysis step focused on creating the design and product, while the development stage included an expert review. The implementation step utilized a formative evaluation approach consisting of self-evaluation, one-on-one interview, and field testing. However, the small-group evaluation and final evaluation stages of the ADDIE model were not yet conducted. This research developed valid student worksheet for mathematical modeling process, integrating assessment, instruction, and learning. Experts affirm that mathematical modeling instruction can unify these elements. While students can enhance their mathematical skills informally and find enjoyment in learning mathematics through mathematical modeling, they may still find the approach challenging due to its inherent complexity, uncertainty, and open-ended nature. This study highlights the importance of designing and implementing mathematical modeling learning and research. Further research should focus on developing assessment questions, student responses, feedback from teachers and peers, student actions towards feedback, self-assessment, followed by additional feedback with a formative assessment cycle to improve student competency. This iterative process aims to enhance student competencies, culminating in a summative assessment of their complete work. Further efforts should also extend the development of student worksheets for the mathematical modeling process to other contexts and larger participant groups.. Additionally, creating instructional videos and integrating technology to support assessment, instruction, and learning in mathematics and other disciplines can further contribute to delivering quality education.

Keywords: *Designing, unifying, assessment, instructional, learning, mathematical modeling*

INTRODUCTION

Assessment plays a crucial role in enhancing the quality of education, underscoring the urgency in educational improvement. Effective assessments should reflect the developmental nature of learning and accommodate students varying stages of progress (Kellaghan & Greaney, 2001; Masters, 2023). In particular, the integration of summative and formative assessments to improve the learning process

remains an important issue, as there are very limited research to address this issue (Guo & Yan, 2019).

Assessment that concluded with judgment is summative, preventing the formative use of the assessment results and leading to fragmented assessment practice. This traditional assessment approach focuses primarily on evaluating how well students have learned what they have been taught (Masters, 2023). Ahmed et al. (2019) recommend giving equal importance to formative and summative assessment methods, emphasizing the involvement of the same teachers in both process. Integrating these approaches can significantly enhance overall student performance. In Indonesia, the challenge for teachers is unifying formative and summative assessments into a cohesive practice. This shows that formative and summative assessments remain separated. The observed tension between summative and formative assessment arises from the separation of assessment practices into two independent practices due to differing function. Summative assessment has been proven through research to show a positive effect on academic achievement (Phillips, 2024). Research and historical evidence suggest that summative assessments have the most significant impact on student learning (Kamara & Dadhabai, 2022). This assessment is closely linked to academic achievement, as it reflects student's level of knowledge (Phillips, 2024).

Assessment in Indonesia remains traditional, with a focus on exams and tests, reflecting a weak orientation toward formative assessment. Survey data analysis identifies four dimensions of teacher formative assessment literacy and understanding: assessment that serves accountability purposes, exams or test-based learning, procedural approaches to learning and assessment, and students' receptive role. Several factors contribute to teachers' limited assessment literacy, including the poor understanding of unifying assessment and insufficient training on assessment methods. Support to improve teachers' understanding of assessment reforms is inadequate, as assessment training is often redundant and included as an additional topic in general professional development programs. Assessment should not be viewed as an attachment to the teaching, as well as learning experience and process, or as an element for qualification and exclusion (García-González et al., 2020). Current grading practices primarily involve exam or test that assign grades without incorporating feedback from teachers and peers and facilitating follow-up improvements by students in their work.

THE IMPORTANCE OF RELATIONSHIP ASSESSMENT, LEARNING, INSTRUCTION

Burket (2016) reported that the formative use of summative assessments is a common practice among Department of the Army tactics instructors, and its continued or expanded use of application could further enhance student learning. In contrast, formative assessment data collected in portfolios can be a useful resource for summarizing learning outcomes. Formative assessments, improved by teacher and peer feedback can be compiled as portfolios and repurposed as summative assessments for reports. This approach, known as summative assessment used formatively, utilizes test information to support learning. Schools can close learning gap by frequently assessing their students and using the results to make changes in their instruction. Andersson and Palm (2017) suggest that reducing grading practices allow teachers and students to explore and use a variety of new and innovative assessment practices, fostering the improvements in teaching and learning.

There are very little information about how teachers comprehend and implement the 2013 curriculum and independent curriculum reforms in the classroom. Classroom observations of two junior high school teachers, reveals very little evidence of learner agency practices. As a result, teachers' pedagogical practices remained unchanged, with teaching methods remaining predominantly teacher-centered. Expanding on this evidence, challenges arises in adopting soft technology in countries where classroom instruction is largely influenced by behaviorist teaching, learning, and assessment. Ehlers and Schwager (2016) report that the decision to implement grade inflation (the final grade given by teachers is based on a series of cognitive and behavioral determinants, based by the belief that learning is a continuous development where effort is inseparable) has led both teachers and students to believe that teaching, learning, and assessment in the classroom as meaningless. Meanwhile the growing pressure to engage in malpractice to achieve high grades is increasing, threatens the integrity of education system and the reputation of schools. This shows the importance of focusing first on students' interest in learning before focusing on grade.

De Lisle (2015) reported that a focus on changing teaching philosophies and practices should be the primary focus of any policy aimed at improving classroom assessment. Such reforms would facilitate the efficient implementation of embedded formative assessment without relying on high-stakes summative agendas. Therefore, to effectively implement formative-focused continuous assessment, countries in the South region should first promote student-centered and constructivist teaching models that support these desired assessment reforms. It is important to design instruction and learning with the goal of changing the assessment practices. Despite the implementation of student-centered pedagogy, summative assessments/exams/test remains a priority. In other words, the learning approach often becomes mechanistic and superficial due to the persistence of traditional assessment methods. A significant issues in current assessment practice is the underutilization of assessment information which could and should be leveraged to support teaching and learning processes.

THE IMPORTANCE OF REAL-WORLD PROBLEMS

Posing real-world questions to students can enhance their awareness on legal and social issues, fostering connections between the law they study, societal experiences, and professional practices (Glofcheski, 2017). In contrast, when questions/problems are hypothetical, students may feel pressured by the assumption that the teacher already has a predefined answer before he asks the question. But if it is real life in this case, it is up to you to make a logical argument (Carless, 2015). The transmission of knowledge and theory does not prepare university graduates for future employment. Therefore, teaching, learning, and assessment methods must be authentic and meaningful, and designed to equip students to adapt to the demands of a constantly evolving world (Oraison et al., 2019). Most importantly, assessment questions must go beyond the classroom and connect to real-world situations and workplace contexts (Gedera, 2023). Mathematics education, in particular, should incorporate mathematical modeling instruction starting from elementary school through to college level.

Glofcheski (2017) used authentic problem news reports and reflective media diaries as tools for authentic assessment. This encourage students to distribute their efforts more evenly throughout the semester, fostering an understanding of the connection between learning activities and summative assessments (Glofcheski, 2017). Incorporating real-world problems is also very crucial in mathematics education. Teacher-created problem often share similar shortcomings, such as being superficial, mechanistic, or detached from unedited real-world problems. Additionally, fabricated questions typically have solutions derived from predetermined sources (Glofcheski, 2017). Despite evidence supporting reform agenda, teachers have implemented innovative assessment frameworks only at a superficial level, often characterized by a mechanistic and procedural approach (Ratnam-Lim & Tan, 2015; De Lisle, 2015). Resistance to assessment reform is caused by several factors, including a lack of assessment literacy, particularly in unifying assessment, instruction, and learning. Cabrera and Pentang (2023) suggest that an innovative approach, such as offline computer-based assessment tools, can assist teachers in addressing challenges related to conducting quarterly assessments and preparing assessments reports. Current assessment practice only focuses on generating summative reports, neglecting the development of students' competency in learning, highlighting the importance of this research. There is increasing recognition that general abilities, often referenced as 21st-century skills, in enhancing learning outcomes. Consequently, there is consensus on the need of developing these skills to prepare students for success in a modern, knowledge- and innovation-based society. Integrating these skills into existing teaching practices must be a priority (WEF, 2016). Castrillón-Yepes et al. (2024) recommend incorporating several key aspects into teaching process, including simplification of situations or phenomena, control of variables, deliberate observation, data collection, conscious use of measuring tools (emphasizing the role of the user) and mathematization.

Indonesia was ranked in 68th place in The Program for International Student Assessment 2022 with a mathematics score of 379, indicating a need for improvement (Media Indonesia, 2024). Indonesian students struggle with context-based problems, particularly in translating real-world scenarios into mathematical models (Wijaya, 2015). They often face challenges in generating mathematical models due to difficulties in making assumptions. This highlights the weakness of Indonesian students in transferable skills. To achieve innovative assessment, instruction, and learning must adopt innovative approach. Collaboration between instructional designers and assessment developers to design and develop learning systems with built-in stealth assessments can optimize

instructional effectiveness (Shute & Kim, 2014). A proposed solution for addressing students' weakness in transferable skills is to unify assessment, instruction, and learning using mathematical modeling. The research aims to develop student worksheets on the mathematical modeling process that integrate assessment, instruction, and learning. The central research question is: What are the characteristics of student worksheets for the mathematical modeling process that unify assessment, instruction, and learning?

METHODOLOGY

This research employed developmental research design (Akker et al., 2006) to create a valid student worksheet for mathematical modeling process, aiming to unify instruction, assessment, and learning. This research utilized a modified ADDIE (Analysis, Design, Development, implementation, and Evaluation) model, encompassing the stage of analysis, design, development, and implementation. However, the implementation phase was limited to one-to-one review and did not include small group testing and field test. The evaluation stages have not yet been conducted. In the analysis stage, real-world situations, instruction, assessment, learning and the characteristics and principles of mathematical modeling problems were analyzed. The design stage focused on designing and producing mathematical modeling problems. During the development stage, mathematical modeling student process worksheets were prepared and were validated by experts. The implementation stage involved a one-to-one review of the mathematical modeling process student worksheets. To implement the mathematical modeling process student worksheet, this study applied the evaluation framework from Tessmer's (1993), which includes self-evaluation, one-to-one, expert review, small group, and field test. Figure 1 shows the formative evaluation for implementation. Self-evaluation was conducted during the design stage, and expert review took place at the development stage. This research only reached the self-evaluation, expert review, and one-to-one stages.

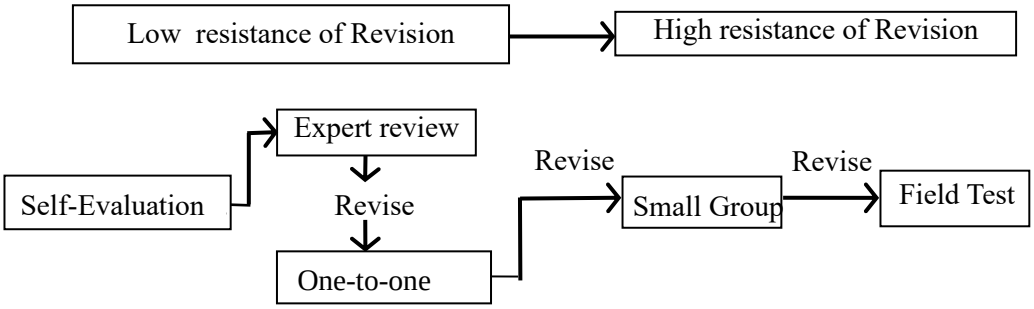


Figure 1 Design of formative evaluation (Tessmer, 1993; Zulkardi, 2006)

1. Participant

This study was evaluated by five experts, selected based on these following criteria: doctoral candidate, doctorate, or professor holder that expert in realistic Mathematics education/mathematical modeling instruction, and educational assessment expert. Purposive sampling was employed to ensure the inclusion of specialized experts who could support the study in achieving its objectives. Five experts validated the student worksheet process to unify assessment, instruction, and learning: one world-class educational assessment expert and four experts in realistic mathematics education. One-to-one review was conducted with Rici, astudent at SMKN 3 Kayuagung.

2. Instruments

Mathematical modeling process student worksheet and its instrument/assessment sheet to unify instruction, assessment, and learning.

3. Data gathering and analysis procedures

The data-gathering procedure involved a walk-through, based on expert review and one-to-one reviews,

to obtain valid Mathematical modeling process student worksheets. Researchers contacted experts via email, WhatsApp, ResearchGate, or Facebook. Data analysis was based on comments and feedbacks from experts on a one-to-one review.

RESULT AND DISCUSSION

1. Analysis stage

An analysis of real-world situations, assessment, learning, material, curriculum, and student, was conducted to select a relevant real-world context for mathematical modeling questions. The chosen context was the queue at Bank Sumsel Babel. Instructional analysis focused on identifying how to support students' learning, leading to the design of mathematical modeling process worksheets. Research in Indonesia regarding long experience in the examination system is still limited, and the concept of teacher assessment remains primarily focused on grading examination results. Many researchers have worked to mitigate the negative and destructive side effects of assessments that undermine personal worthiness and prospects. This effect have led many educators to view summative assessments negatively while promoting the use of formative assessments (Black et al., 2004; Taras, 2008).

2. Design stage

Mathematical modeling process student worksheets are designed to integrate assessment, instruction, and learning. Instruments are developed to assess the effectiveness of these worksheets in achieving this integration. Researchers identify relevant real-world problems to incorporate into the worksheet. Additionally, experts are selected to evaluate and review the role of these worksheets, including world-class assessment experts and specialist in mathematical modeling or realistic mathematics education. The design stage resulted in student mathematical modeling process worksheets, instruments, and the selection of the expert for review. Researchers developed these worksheets to integrate instruction, assessment, and learning. The context of a teller queue at Bank Sumsel Babel, Kayuagung was used as the basis for designing the mathematical modeling. Effective implementation of formative assessment is seldom observed in classroom practices across both Western and Eastern contexts (Yan & Brown, 2021). The embedded micro-assessment approach minimizes specific assessment events so that assessment and learning become a single experience (High Resolves, 2020). As institutions strive to improve assessment practices, it is crucial for students to clearly understand what processes and products (outcomes) are expected from them and how those processes and products are evaluated (Gedera, 2023). This indicates that the assessment process can be continuous, combining both summative and formative assessments. Changing assessment paradigms to integrate behaviorist, constructivist, and sociocultural perspectives is more feasible during the pre-service stage than after restructuring. This approach emphasizes the unification of assessment, teaching, instruction, curriculum, and learning.

3. Development stage

The development stage involves preparing mathematical modeling student process worksheets and validating them with experts. The expert review panel consist of five (5) individuals: four (4) experts in mathematical modeling instruction/realistic mathematics education and one expert in educational assessment. Expert reviewers in Realistic Mathematics Education suggested adding an explanation about the context of Bank Sumsel Babel and its queue system. So, the researcher revised the Process Student Worksheet by explaining the context of Bank Sumsel Babel, the working hours/opening hours of Bank Sumsel Babel, as well as the customer queuing system. Educational assessment experts stated that this Modeling Process Student Worksheet could serve as both a summative formative assessment tool. It has the potential to unify these assessments if it includes summative scores and learning feedback. Additionally, it can integrate assessment and learning into a single cohesive event, as illustrated in Figure 2. This approach is crucial for driving changes in education, particularly in assessment and learning, to address the 21st century demands such as fostering character development,

general competency, and subject-specific knowledge through unified assessment and learning events. The use of summative assessment for formative purposes represents an often underutilized yet highly impactful strategy for enhancing student learning outcomes (Black et al., 2004; Stiggins, 2009; Taras, 2008). While much of the current assessment literature focuses on the distinguishing between summative and formative assessments, many researchers agree that the same tests can be used for both summative and formative purposes.

4	Student Worksheets in this mathematical modeling process can integrate/unite/combine assessment and learning	Depends on…	Yes, if you provide both summative scores and learning feedback.

Figure 2 Comments from educational assessment on Expert Review for statement 4

Experts in realistic mathematics education commented that the assessment format is appropriate, the guiding questions effectively steer students toward solving the Fermi Problem, and the design successfully integrates theoretical concepts with assessment while unifying assessment and learning.

4. Implementation Stage

The implementation stage involved conducting a one-to-one review of the mathematical modeling process student worksheets to validate their effectiveness in unifying instruction, assessment, and learning. Students were tasked with answering questions and providing feedbacks on the student process worksheet. This approach aims to develop students' ability in the mathematical modeling process according to the modeling cycle, and fostering learning by enabling the formation of a schema (long-term memory) of the mathematical modeling process. Ärlebäck et al. (2024) state that the Fermi Problem can enhance cultural and intercultural awareness in problem-solving, emphasizing the role of Mathematics as a tool to understand, describe, predict, and explain real-life situations. Because students learn little from the constructivist approach, most teachers who try to implement classroom-based constructivist teaching end up guiding students. The relatively few students who learn through discovery do not show signs of superior learning quality (Riyanto, 2023). So, these small questions/probing questions/scaffolding are very necessary for learning to occur in students.

Students can also successfully determine important information with the guidance of researcher. At every age level, guided discovery is more effective than simple discovery learnings (Weisberg et al., 2015). Student worksheets serve as cognitive scaffolding for students to solve rich problems. Thus, the structure of student worksheets is designed and structured to include a number of activities that can help students to work independently in solving rich questions (Fitriati & Novita, 2018). Students can determine one piece of information that is not yet known, including the length of teller's service for customers. Research has so far discussed formative and summative assessments separately, such as only discussing formative assessments (Wolterinck, 2022). This statement still looks at the dichotomy of formative and summative assessments. Therefore, the results of this research are important to close this issue. Furthermore, Assessment practices for teacher learning are influenced by the readiness of students and teachers regarding innovative ideas, as teachers and students experience a lack of assessment literacy, belief, attitude, motivation, and commitment.

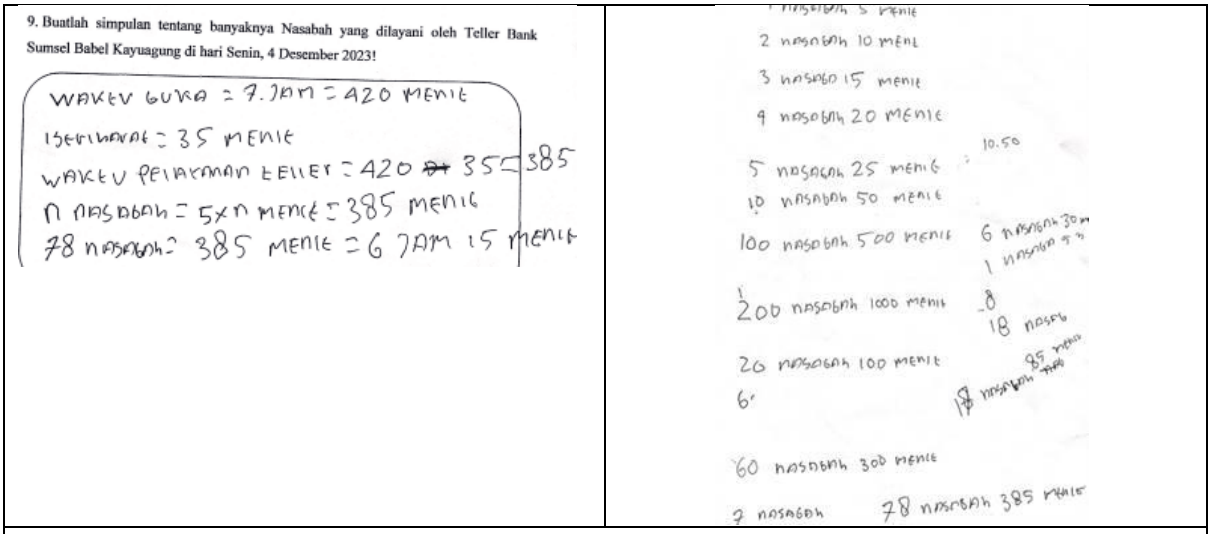
The student found that the insufficient information regarding the teller's service time to customers due to the uncertainty or different for each customer. Student only estimates by taking one call data: 22.06 to 12.11 which is 5 minutes. The role of assessment according to the traditional view is to determine how well students have mastered curriculum content, usually by administering tests or exams at the end of an instructional period including topic, semester, or school year (Masters, 2023). Estonia's national approach to assessment demonstrates a comprehensive perspective on the purpose of assessment within the learning process. This approach prioritizes fostering overall student development by shifting from Traditional Summative Assessment to Individualized Formative Assessment tailored to individual learning needs (Eisenschmidt et al., 2023).

Students can complete the table based on the available information. The results of this study indicate that students have autonomy and agency in their own assessment and learning. Arrafii (2021) suggests that students and teachers should be given the autonomy and agency to implement reform mandates without being burdened by strong expectations to meet external accountability (e.g., public exams). Additionally, the stakes of end-of-year exams should be reduced as the sole determinant of student graduation. By nature, 21st century learning activities are often open-ended and involve an unlimited collection of information, and there may be an ongoing redefinition of problem objectives (Scoular, 2019). Students can determine the formula informally by stating that 1 customer needs 5 minutes. Significant efforts have emerged in developing programmatic approaches to assessment; recognizing that summative (high-stakes) and formative (low-stakes) assessments take place in the overall assessment of trainee learning. However, different methods are needed to assess or evaluate different skills and abilities (Bok et al., 2015; Barrett, 2016). In resolving issues and tensions in the relationship between formative and summative assessment, a marriage rather than divorce counseling approach should be adopted (Swayamprakasam et al., 2014; Barrett, 2016). On the other hand, research indicates that summative assessment is crucial for learning process. Although it does not evaluate a student's ability to apply that knowledge, summative assessment is useful in education that gives grades but it cannot improve their learning without using feedback in formative aspects when using it (Phillips Jr., 2024).

Student assumed that rest, prayer, and meal time totaled 35 minutes, with the overall service time being 7 hours. Stillman and Brown (2014) show that the inability to mathematize in the classroom is connected to the inability to apply relevant mathematical skills within modelling context, rather than a lack of relevant mathematical skills per person, an orientation view of mathematical applications, or persistence on tasks. Whether a student is using an informal methods or not using formal mathematical concepts is illustrated in Figure 3. This indicates that modeling learning can facilitate diagnostic assessments. Initially, summative and formative assessments were differentiated based on the objectives and results of the evaluation, as well as the time of implementation. Summative assessment is considered important because it is believed to improve student motivation and learning performance, with grade often considered as the most desirable performance criterion (Stiggins, 2009). This causes to a perception that learning is considered only as individual competition and not involving personal improvement and collaboration. Therefore, the dichotomous grouping of students into 'stronger' and 'weaker' is unavoidable and the gap between them intensifies. As a result, the weaker group often gives up trying (Black et al, 2004).

The student has not yet mastered the relationship between multiplication and division because he still used an informal way of converting 385 minutes into one time. This aligns with previous findings by Saxena et al. (2016) who state that the students' performance has not been at the desired level, and the students did not solve mathematical problems in an interesting way, including the ability to improve Student's capability of moving towards formal mathematics through informal mathematics in the concepts of division and multiplication. The student was able to estimate the number of customers served by Bank Sumsel Tellers in one day informally. However, he did not validate and reflect on his work. This represents a promising opportunity for the implementation of integrating assessment, instruction, and learning through mathematical modeling. Research indicates that students face challenges in understanding problems, building real models by defining situation-related variables and making assumptions, generating mathematical models, performing mathematical calculations, and verifying models (Anhalt et al., 2018; Deniz & Akgün, 2018). Students only use known numbers or information without creating mathematical models and do not validate mathematical models. Pre-service teachers tend to solve problems using numerical values presented in context rather than using model construction (Tekin Dede, 2016). Students and prospective teachers face difficulties creating models due to their limited capacity to fully internalize it (Kaya & Keşan, 2022). Students do not plan their approach to problems carefully and often resort to mathematical solutions using the provided numerical values (Çoksöyler & Bozkurt, 2021; Kaya & Keşan, 2022). The students were able to estimate roughly and informally even though they did not provide validation, interpretation variables, or mathematization. This is a golden opportunity for Indonesian students to integrate assessment, instruction, and learning through mathematical modeling. According to research, mathematization is challenging (Gould & Wasserman, 2014). Student's feedbacks state that this worksheet is both confusing and interesting, and that mathematical modeling is new and not commonly taught in schools.

This feedback supports the model teacher, the observer teacher, and the students themselves as research subjects stating that modeling learning is good to apply in the future because it is interesting, challenging, and meaningful for students and makes students motivated to learn.



Translation: Draw conclusions about the number of customers served by Bank Sumse Babel Kayuagung tellers on Monday, December 4, 2023.
Rici's answer: Opening time = 7 hours = 420 minutes. Rest 35 minutes. So, teller service time = 420 - 35 = 285 minutes. n customers = 5 × n minutes. 78 customers = 385 minutes 6 hours 15 minutes.

Figure 3 Student's conclusion for the number of customers served by tellers in one day

Instruction, assessment, and learning can be unified through mathematical modeling. Knowledge of a particular discipline or context is essential for demonstrating a skill in that context. As skill proficiency increases in one area, it does not necessarily transfer to other contexts where in-depth knowledge is lacking (Scoular et al., 2020). Secondary school teachers do not have adequate abilities to assess student learning because they are not trained in assessment (Yulia, 2014). Mathematical modeling instruction may be an alternative for training teachers in this innovative assessment. The conception and practice of teacher assessment at the school level remain largely unknown in most developing countries. (Kellaghan & Greaney, 2001). Secondary school teachers in Indonesia are required to implement the 2013 Curriculum and Independent Curriculum reforms. However, anecdotally, they have insufficient understanding and skills to implement these reforms. Thus, research can guide teachers and lecturers in implementing the integration of assessment, instruction, and learning through mathematical modeling (Riyanto, 2024).

Ratnam-Lim and Tan (2015) examine efforts to uncover challenges ('walls') in implementing 'Holistic Assessment' on a large scale, particularly highlighting the tensions among stakeholders regarding the interaction between formative assessment and accountability systems. In other words, the implementation of scaled formative assessment merged within an exam-oriented culture. Ratnam-Lim and Tan (2015) report that contextual factors in our social educational system may hinder the effective implementation of formative assessment. These factors include pressures from an educational tradition focused on performance examinations, inadequate teacher training, and practical constraints such as lack of time or support from school leaders, and the challenges teachers face in balancing their various roles. Thus, research into the integration of assessment, instruction, and learning is very essential. Assessment can be uniquely summative if the assessment stops at judgment (Taras, 2008).

Teachers' poor understanding of formative assessment is closely related to teachers' lack of understanding of innovative instruction and learning to implement innovative assessments. Teachers do not have the essential competencies in learning assessment to successfully apply them in their teaching. Language teachers' skills in conducting assessments are crucial for effectively implementing all types of assessment (Ahmed et al., 2019). Further professional training programs are urgently needed to improve teachers' theoretical understanding of formative assessment. New findings on the development of continuing education and teacher practice will highlight the importance of mathematical modeling

for society (Wieganf & Ferri, 2024). It is also suggested that teachers incorporate technology in designing assessment tasks (Cabrera & Pentang, 2023). However, their research only focuses on summative tests, not formative assessments.

Stiggin (2009) argues that our nation obsessed with the belief that the school improvement can be achieved through better, more frequent, and more intensive standardized testing. However, the problem is that these tests, which are ostensibly developed to 'not leaving students behind', actually causes a large portion of students to fall behind, as they lead many to give up in despair, producing the opposite effect of what the policymakers intended. This indicates the importance of implementing the results of this research. The use of formative assessment in a summative manner creates tension. This statement can also be overcome with instruction, assessment, and meaningful learning that creates students' desire to learn. Blum et al. (2019) state that the design of activities in mathematical didactics can be in the form of the design of tasks, lessons (lesson plan), sequences of teaching, textbooks for mathematical learning, curriculum, assessments, and ICT-based teaching material or programs for teacher education and must be done by teachers, educators, book writers, curriculum and assessment developers, designer of ICT, and researchers. Summative exams that cover a w year or even a semester of learning are rare, and the Core National Curriculum directs teachers to base their end-of-semester or end-of-year classes on all the information, formative and summative, gathered over that period (Kupiainen and Ouakrim-Soivio, 2023).

CONCLUSION

Research has produced student worksheets on mathematical modeling processes, incorporating characteristics following VUCA (volatility, uncertainty, complexity, and ambiguity). This serves as a form of teacher assistance (scaffolding) for novice students in solving VUCA problems and following the process of solving mathematical modeling problems. The context of teller queues at Bank Sumsel Babel Kayuagung is used to unify instruction, assessment, and learning. This result align with the results of Riyanto (2024). This research did not reach grading as the final product of a summative assessment or several formative assessment cycles were carried out to get to a summative assessment. Further research is recommended to begin with the design of assessment questions, student responses, feedback from other people (teacher and peer), student actions towards feedback, self-assessment, and then feedback again with a formative assessment cycle to improve student competency. Ultimately, grading should be based on complete student work for a summative assessment as the final product. Additionally, further development for student worksheets on the mathematical modeling process is recommended for other contexts and with more participants. Alongside these worksheets, instructional videos (technology) should be incorporated to unify assessment, instruction and learning in mathematics or other fields, are these elements are inseparable in creating quality education.

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DATA AVAILABILITY STATEMENT

Data will be made available on request.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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