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Mathematics teaching module design with *tri-n (niteni, nirokke, nambahi)* with problem based learning model

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Abstract

This research aimed to develop fourth-grade elementary school students' integration of learning with problem-based learning and the teachings of Ki Hadjar Dewantara Tri-N (Niteni, Nirokke, Nambahi). This research is research and development with the PPE development model which consists of three stages, namely Planning (Planning), Production (Product Preparation), and Evaluation (Evaluation). This research was conducted at Ngentak Sanden Elementary School, Bantul Regency in Grade IV mathematics subjects. The data collection instrument uses an assessment sheet of mathematics teaching modules that have been validated by experts (expert judgment). The data collection technique in this study used product validity tests. The initial step of this research is to convert qualitative data from the results of expert assessment, material and media into quantitative data forms. The next step is to calculate the actual score and the average of the actual score. Quantitative data in the form of average actual scores are then converted into qualitative data using the Likert scale. The results of validation by material and media experts, the module is said to be valid with an average actual score of 98.5 with good criteria and 51.7 with Very Good criteria. The results of this study are expected to provide benefits for students in learning to improve mathematical reasoning. This research was successfully carried out by designing and developing a mathematics teaching module with a problem-based learning model based on Tri-N (Niteni, Nirokke, Nambahi) in a Grade IV Elementary School.

INTRODUCTION

Background of the Study

The problems faced in education development emerge as several aspects, namely improving the quality of education, equitable distribution of education throughout the region, the efficiency of education management, and the role of the surrounding community (Maghfiroh & Hardini, 2021). The obligation of education serves as a preservative of state culture, which is also oriented towards the development of human abilities that are competitive and moral (Turnip & Karyono, 2021). Moral human resources are supported by improving the quality of education even better (Ismiyanti, 2018). Improving the quality of education can be done in various ways, one of which is through the development of teaching modules used in the implementation of the Merdeka Curriculum .

The teaching module in the Merdeka Curriculum is a vital tool for the smooth implementation of new paradigm learning. In this case, the Merdeka Curriculum teaching module refers to several tools or media, learning methods, implementation instructions, and learning guidelines designed systematically, interestingly, and following students' demands (Setiawan et al., 2022). The teaching module in the Independent Curriculum is an implementation of the Learning Objectives Flow (LOF), which is a development of Learning Outcomes (LO) with the target of realizing the Pancasila Student Profile. The teacher prepares the teaching module of the Merdeka Curriculum according to the phase or stage of student development.

The Merdeka Curriculum teaching module must also consider what students will learn under the learning objectives. The development base must also be long-term oriented. This Merdeka Curriculum teaching module is developed and designed by teachers in each educational unit. Therefore, every teacher must compile teaching modules entirely and systematically. Thus, learning can occur interactively, inspirationally, fun, and challenging, motivating students to actively participate in learning and providing space for initiative, creativity, and independence by talents, interests, and physical and psychological development. However, in reality, many teachers have been unable to compile and develop teaching modules following the learning objectives.

Problem of The Study

This research was motivated by observations that there were still many teachers who could not compile appropriate teaching modules, especially in the application of the Merdeka Curriculum . The Merdeka Curriculum teaching module

designed by teachers should ideally show that the learning process not only designs a learning process that requires students to master and be proficient in aspects of knowledge, but also must be able to develop the attitudes and skills of students. Thus, teachers need to know and understand the concept of teaching modules that will be compiled to make learning process more interesting and meaningful for students (Tinggi & Islam Binamadani, 2022).

The Merdeka Curriculum focuses on providing teachers the freedom to develop the prepared teaching modules. Teachers have many opportunities to choose and modify the teaching modules that the national government has provided. In terms of modifying teaching modules here, they must follow the corridor by adjusting the teaching modules to the conditions and characteristics of students per the Learning and Assessment Guidelines. The primary purpose of developing teaching modules contained in the Learning and Assessment Guide is to develop teaching tools. Teaching tools compiled and developed by teachers can guide teachers in carrying out learning by meeting criteria according to the needs and characteristics of their students. The substantial essence of the Merdeka Curriculum is independence; namely freeing students and educators to form a strong independent mentality in facing this era of disruption.

Research's State of the Art

The use of teaching modules in learning follow the conditions of students will affect students' level of understanding (Suryanto et al., 2017). Learning in elementary school includes several subjects, one of which is mathematics. Mathematics as a science has a vital role in various disciplines and is applied to advance the human mindset. Few people consider mathematics to be a tough and complicated field of study. Angular material is one of the mathematics learning materials related to problem-solving ability (Marshanawiah et al., 2023).

As one of the materials in mathematics learning, angular material must be completed with learning strategies. One of the learning strategies used is with a learning model that is in accordance with a scientific approach. One of the appropriate learning methods that can be used to support the scientific learning process is Problem-Based Learning (PBL) (Rahmadani & Acesta, 2017). Problem-Based Learning is learner-centered because students are actively involved in problem-solving activities. Problem-based learning will allow learners to find meaningful learning, learners will be trained to solve real problems that often arise. So that

learning with the Problem-Based Learning (PBL) method is expected to be more effective (Ariyani & Kristin, 2021; Rahmat, 2018).

Learning with the Problem-Based Learning learning model is an activity to collect information or data, and this can be done by finding and studying reading materials and references related to the given problem, or by looking for factual data in the field by observing or recording symptoms (Fauzia, 2018; Rustini et al., 2023). Thus, this Problem-Based Learning learning model is a learning model characterized by learning that involves students in an activity to produce a product, learning that involves students in problem-solving and active participation of students in the form of groups to find solutions to the problems given (Agus et al., 2022; Melindawati et al., 2022).

PBL learning by involving students in problem-solving can be integrated with the teachings of Tamansiswa initiated by Ki Hadjar Dewantara, namely Tri-N. The Tri-N is a teaching method that has three phases (Damayanti &; Rochmiyati, 2019; A. Widyawati et al., 2019). Three phases in Tri-N teaching, namely *niteni*: students initially observe and pay close attention to the teacher's direction and explanation of the subject studied (Enawati &; Rochmiyati, 2020; Oda et al., 2022; A. N. Widyawati & Setyawan, 2019). *Niroake*: is the phase of the teacher making sure students understand what is conveyed well. If students cannot imitate, the teacher needs to re-explain so that children can imitate what has been described well. If students could imitate well in this phase, the *niteni* phase is proven to run according to purpose (Oda et al., 2022; A. N. Widyawati &; Setyawan, 2019). The final phase of this teaching is *nambahake*. In this final phase, students are free to creativity. Students could have an excellent creative attitude if these three phases are implemented well.

Novelty, Research Gap, & Objective

Based on the results of preliminary studies, with the application of the Merdeka Curriculum in educational units, it is concluded that teachers currently need a complete and systematic teaching module following the conditions and characteristics of students and in line with the goals. This condition is because the Merdeka Curriculum teaching module that is widely circulated and provided by the government has not had much to do with the students' problem-solving ability. The teaching module has not used much of the problem-based Learning model that encourages student involvement in producing a product, learning that involves students in problem-solving, and their active participation in groups in finding solutions to given problems.

From the background of this problem, it is certainly very relevant if the development of the Problem-Based Learning teaching module is integrated with one of Tamansiswa's teachings, namely Tri-N. The Tri-N teachings initiated by Ki Hadjar Dewantara have three phases, namely *niteni,* where students start observing activities about the subject, then *nirokke* where students can imitate well, then end with *nambahi* activities where students can show their creativity in finding solutions to problems presented in learning activities. With the development of this teaching module, it is hoped that it can be used as a reference for teachers to compile teaching modules needed today.

METHOD

Type and Design

The research method used is research and development. Research and development methods (Research and Development) is research used to produce certain products and test their effectiveness (Ismiyanti & Cahyaningtyas, 2019). The research and development model in education according to Brog & Gall is a process that aims to develop and validate educational products (Sriwanti & Sukmawarti, 2022).

This research used the PPE model developed by Richey & Klein, which includes three stages: Planning, Producing, and Evaluating. In the Planning stage, researchers conduct a demand analysis with literature studies and design an initial draft of the module. At the Production stage (product preparation) researchers arrange products in accordance with planning at the planning stage. Evaluation is the last stage where products in the form of modules are assessed or validated by experts. The mathematics module was validated by material experts, namely two mathematics education lecturers and media experts, namely two mathematics teachers and one mathematics education lecturer (Feriyanti, 2019; Mahari, 2017).

Data and Data Sources

The type of data used in this study is qualitative and quantitative. Qualitative data in the form of assessment results from material experts and media experts. Quantitative data is in the form of scores from qualitative data obtained previously. Data collection techniques use product validity tests. The first step, qualitative data from the assessment of material and media experts is converted into quantitative data form. Then calculate the actual score and the average of the actual score. Furthermore,

quantitative data in the form of the average actual score is converted into qualitative data using the Likert scale.

In articles that use research and development research methods, there are stages of validation. The validation stage is carried out to find out input, suggestions for improvement, and assessment of mathematics modules. Mathematics modules that have been validated and get input, then researchers revise. The aspects assessed in material validation are material feasibility, linguistic aspects, and presentation aspects. The aspects assessed in media validation are design and graphic aspects.

Table 1. Material Expert Validation Results

No	Assessed Aspects	Score	
		V1	V2
1	Feasibility of the aterial	42	39
2	Language	19	22
3	Serving	38	37
Actual Score		99	98
Average		98.5	
Criterion		Good	

Table 2. Media Expert Validation Results

No	Aspects	Score		
		V1	V2	V3
1	Feasibility of the material	44	53	58
	score	44	53	58
Average		51.7		
Criterion		Very Good		

Data Collection Technique

The data collection instrument used is the mathematics module assessment sheet. Before use, this assessment sheet is validated first by an expert (expert judgment) to determine the validity of the instrument. Product assessment sheets are designed with Likert scale rules namely Very Good, Good, Not Good, and Very Not Good (Cahyaningtyas et al., 2019).

Data Analysis

Based on the results of the validity test of the mathematics module by material experts, Good criteria were obtained with an average actual score of 98.5. The validation results from material experts can be seen in Table 1. As for the results of the validity trial of the mathematics module by media experts, very good criteria were

obtained with an average of 51.7. The validation results from media experts can be seen in table 2.

RESULTS

This research has succeeded in developing mathematics teaching modules with a Tri-N-based Problem Based Learning learning model (Niteni, Nirokke, Nambahi) in grade IV Elementary School using development design, namely Planning, Production, and Evaluation. The Planning stage is the first stage where researchers conduct a needs analysis by studying literature and designing an initial draft of teaching modules. This literature study aims to determine the Learning Outcomes (LO) developed in the Learning Objectives Flow (LOF). The teaching modules compiled here also refer to a number of tools or media, learning methods, implementation instructions, and learning guidelines that are designed systematically, interestingly, and according to the needs of students.

The research phase is carried out by designing the initial draft of the module which includes selecting the module format, planning the cover design, page colors, writing form, material description, practice questions, images presented, and font size. This activity is an application of the Tri-N part of add (*nambahi*) which means developing, modifying, creating, adding, subtracting, improving, developing abilities, and expanding understanding.

Next is the Production stage (product preparation). Researchers arrange work on mathematics teaching module products according to plan at the Planning stage. This stage starts with compiling a cover using the Canva application. Then proceed to create the contents of the teaching module in Microsoft Word which includes three parts. The first part is general module information, learning activities, and assessments in the form of LKPD, feedback, and follow-up. The teaching module developed is an application of the Tri-N nirokke section, it means imitating, imitating, implementing, doing something, and practicing in its own way.

The evaluation stage is the last stage where products in the form of teaching modules are assessed or validated by material and media experts. This validation is carried out to find out input, suggestions for improvement, and assessment of mathematics teaching modules and is an implementation of the Tri-N *niteni* section means to pay attention, observe, or listen. In this case, the student pays attention, makes observations, reads or listens carefully, feels, feels with his five senses.

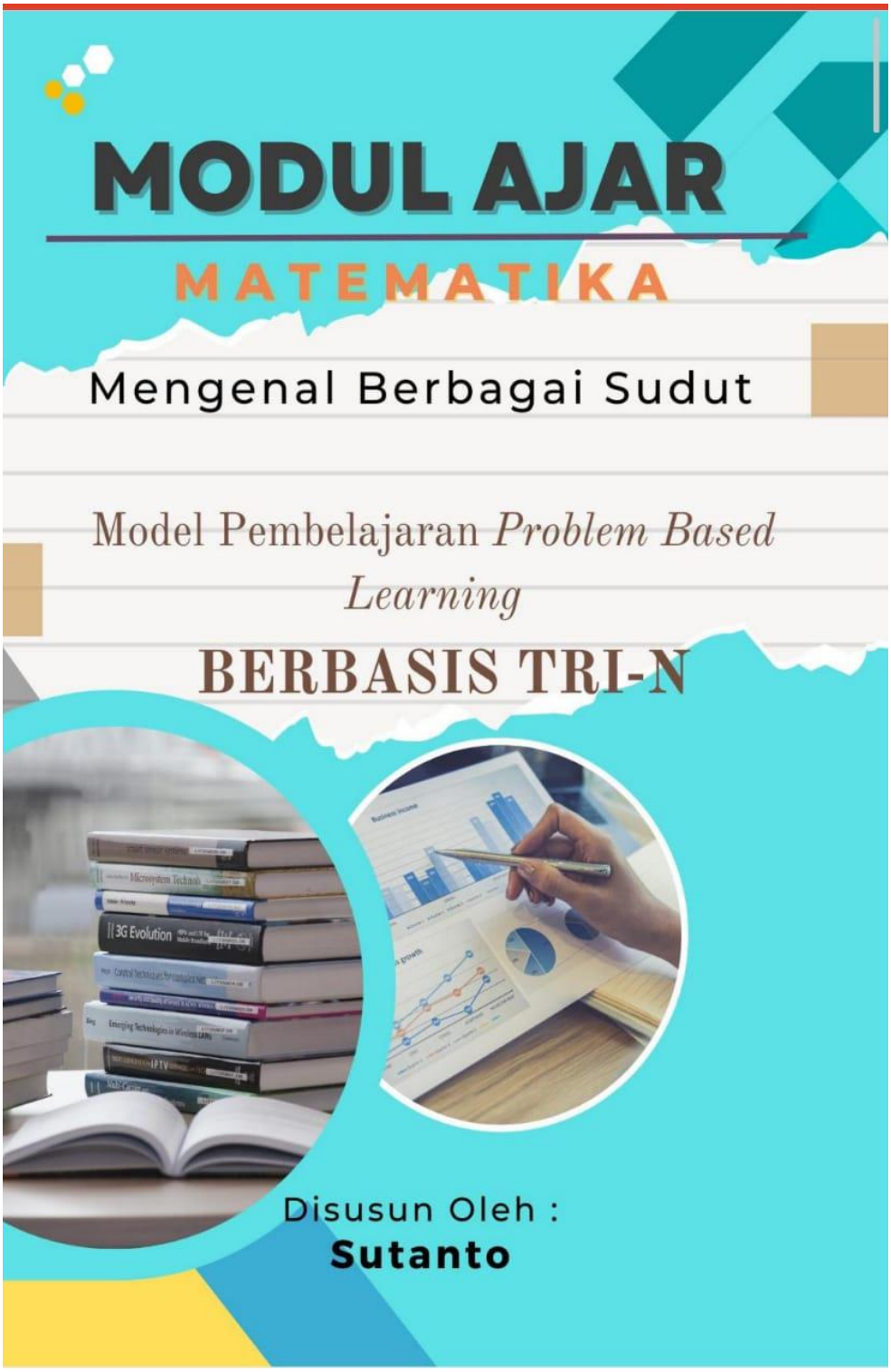
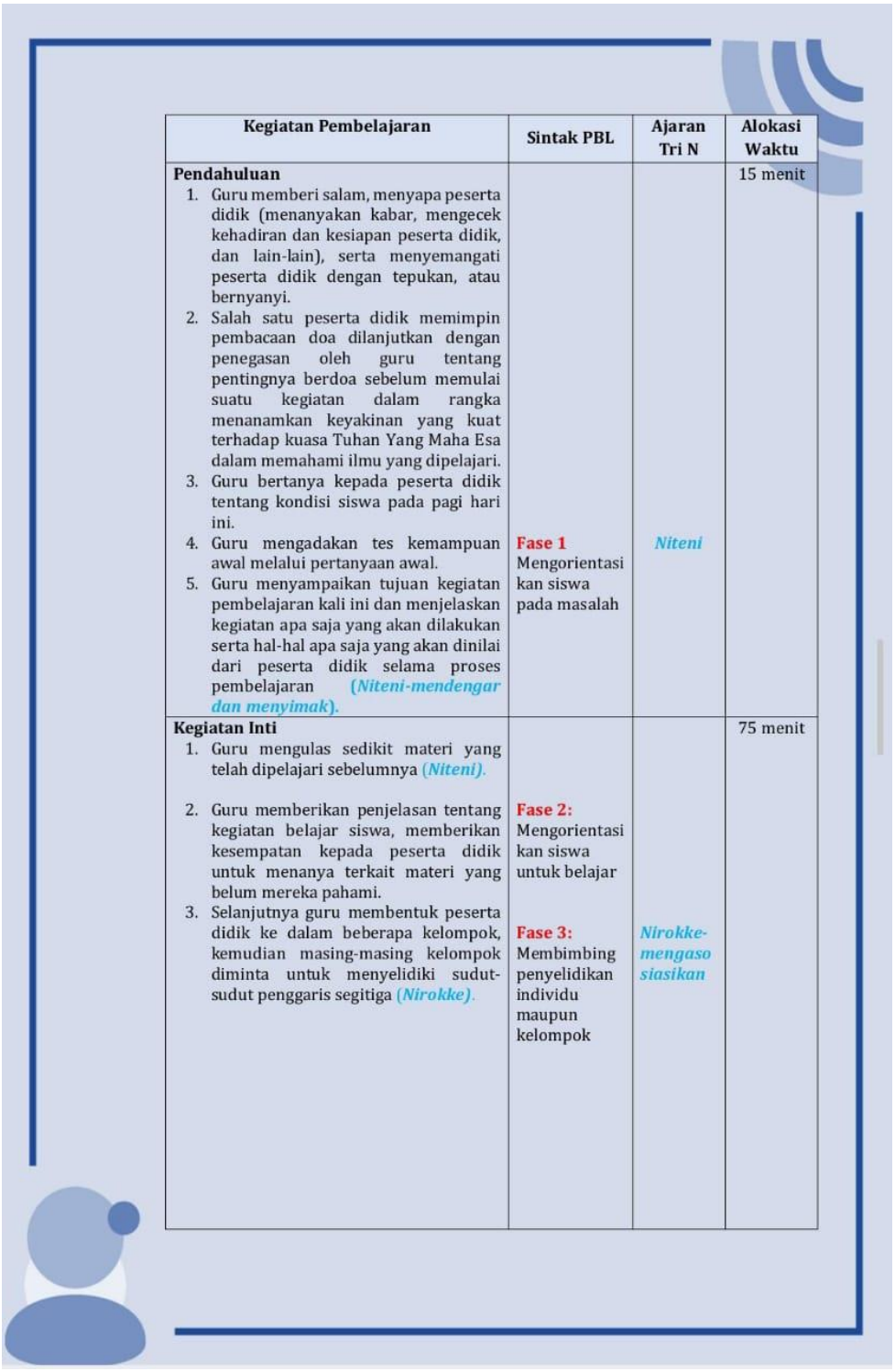
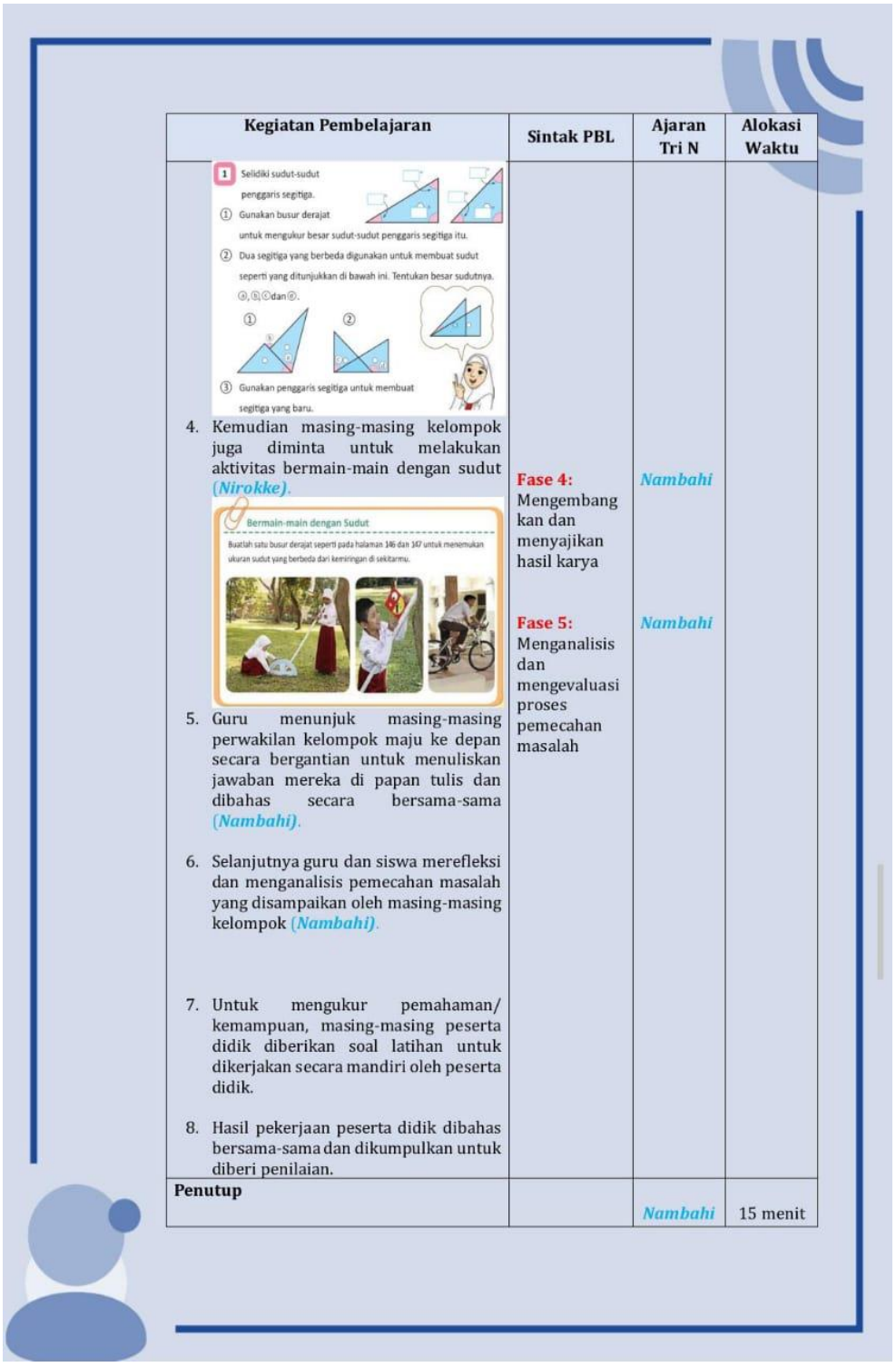


Figure 1. Teaching Module Cover



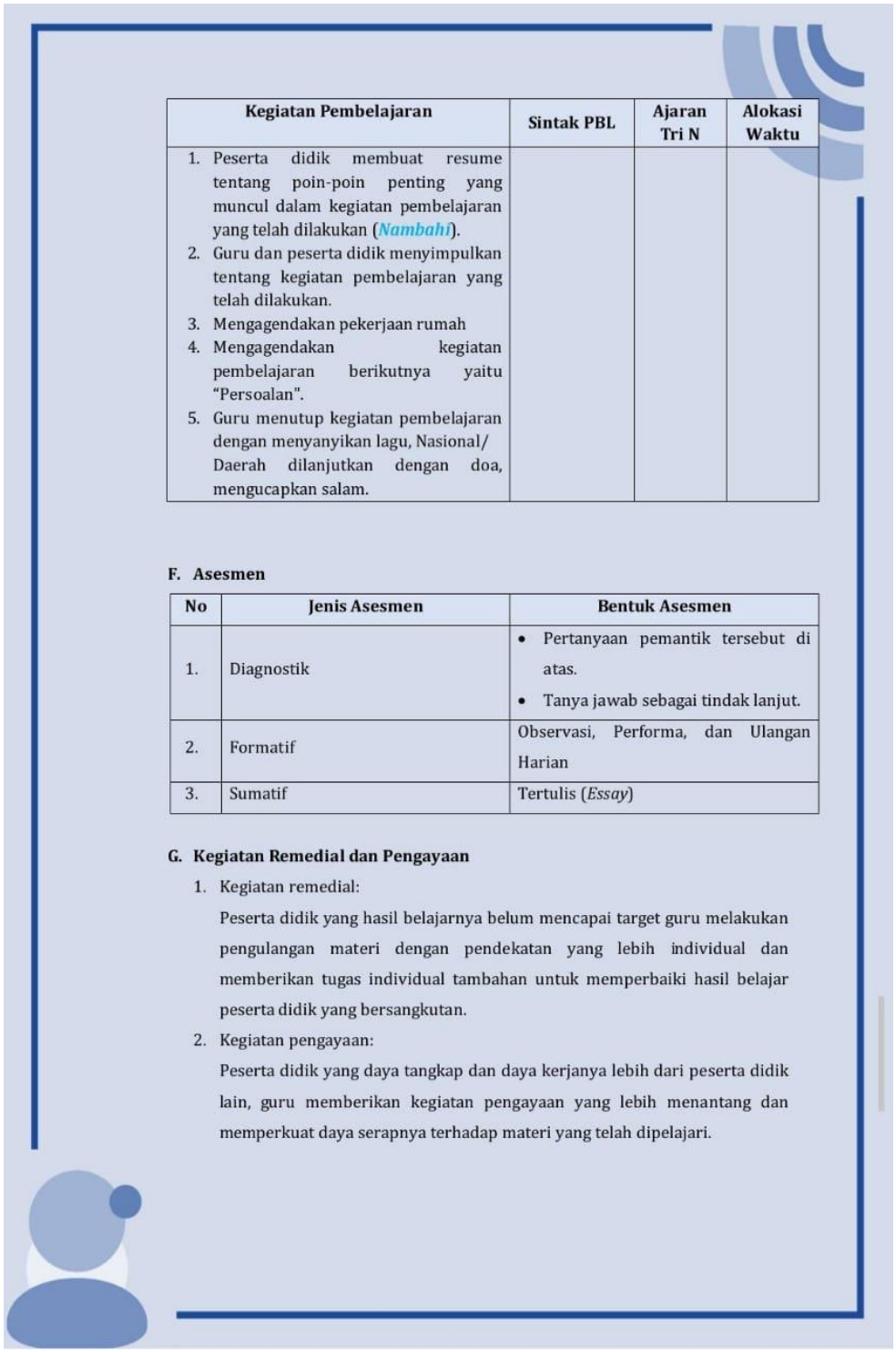
Kegiatan Pembelajaran	Sintak PBL	Ajaran Tri N	Alokasi Waktu
Pendahuluan 1. Guru memberi salam, menyapa peserta didik (menanyakan kabar, mengecek kehadiran dan kesiapan peserta didik, dan lain-lain), serta menyemangati peserta didik dengan tepukan, atau bernyanyi. 2. Salah satu peserta didik memimpin pembacaan doa dilanjutkan dengan penegasan oleh guru tentang pentingnya berdoa sebelum memulai suatu kegiatan dalam rangka menanamkan keyakinan yang kuat terhadap kuasa Tuhan Yang Maha Esa dalam memahami ilmu yang dipelajari. 3. Guru bertanya kepada peserta didik tentang kondisi siswa pada pagi hari ini. 4. Guru mengadakan tes kemampuan awal melalui pertanyaan awal. 5. Guru menyampaikan tujuan kegiatan pembelajaran kali ini dan menjelaskan kegiatan apa saja yang akan dilakukan serta hal-hal apa saja yang akan dinilai dari peserta didik selama proses pembelajaran ***(Niteni-mendengar dan menyimak)***.	**Fase 1** Mengorientasikan siswa pada masalah	***Niteni***	15 menit
Kegiatan Inti 1. Guru mengulas sedikit materi yang telah dipelajari sebelumnya ***(Niteni)***. 2. Guru memberikan penjelasan tentang kegiatan belajar siswa, memberikan kesempatan kepada peserta didik untuk menanya terkait materi yang belum mereka pahami. 3. Selanjutnya guru membentuk peserta didik ke dalam beberapa kelompok, kemudian masing-masing kelompok diminta untuk menyelidiki sudut-sudut penggaris segitiga ***(Nirokke)***.	**Fase 2:** Mengorientasikan siswa untuk belajar **Fase 3:** Membimbing penyelidikan individu maupun kelompok	***Nirokke-mengasosiasikan***	75 menit

Figure 2. Learning Activities



Kegiatan Pembelajaran	Sintak PBL	Ajaran Tri N	Alokasi Waktu
 4. Kemudian masing-masing kelompok juga diminta untuk melakukan aktivitas bermain-main dengan sudut ***(Nirokke)***. 5. Guru menunjuk masing-masing perwakilan kelompok maju ke depan secara bergantian untuk menuliskan jawaban mereka di papan tulis dan dibahas secara bersama-sama ***(Nambahi)***. 6. Selanjutnya guru dan siswa merefleksi dan menganalisis pemecahan masalah yang disampaikan oleh masing-masing kelompok ***(Nambahi)***. 7. Untuk mengukur pemahaman/ kemampuan, masing-masing peserta didik diberikan soal latihan untuk dikerjakan secara mandiri oleh peserta didik. 8. Hasil pekerjaan peserta didik dibahas bersama-sama dan dikumpulkan untuk diberi penilaian.	**Fase 4:** Mengembangkan dan menyajikan hasil karya **Fase 5:** Menganalisis dan mengevaluasi proses pemecahan masalah	***Nambahi*** ***Nambahi***	
Penutup		***Nambahi***	15 menit

Figure 3. Learning Activities



Kegiatan Pembelajaran	Sintak PBL	Ajaran Tri N	Alokasi Waktu
1. Peserta didik membuat resume tentang poin-poin penting yang muncul dalam kegiatan pembelajaran yang telah dilakukan (*Nambahi*). 2. Guru dan peserta didik menyimpulkan tentang kegiatan pembelajaran yang telah dilakukan. 3. Mengagendakan pekerjaan rumah 4. Mengagendakan kegiatan pembelajaran berikutnya yaitu "Persoalan". 5. Guru menutup kegiatan pembelajaran dengan menyanyikan lagu, Nasional/ Daerah dilanjutkan dengan doa, mengucapkan salam.			

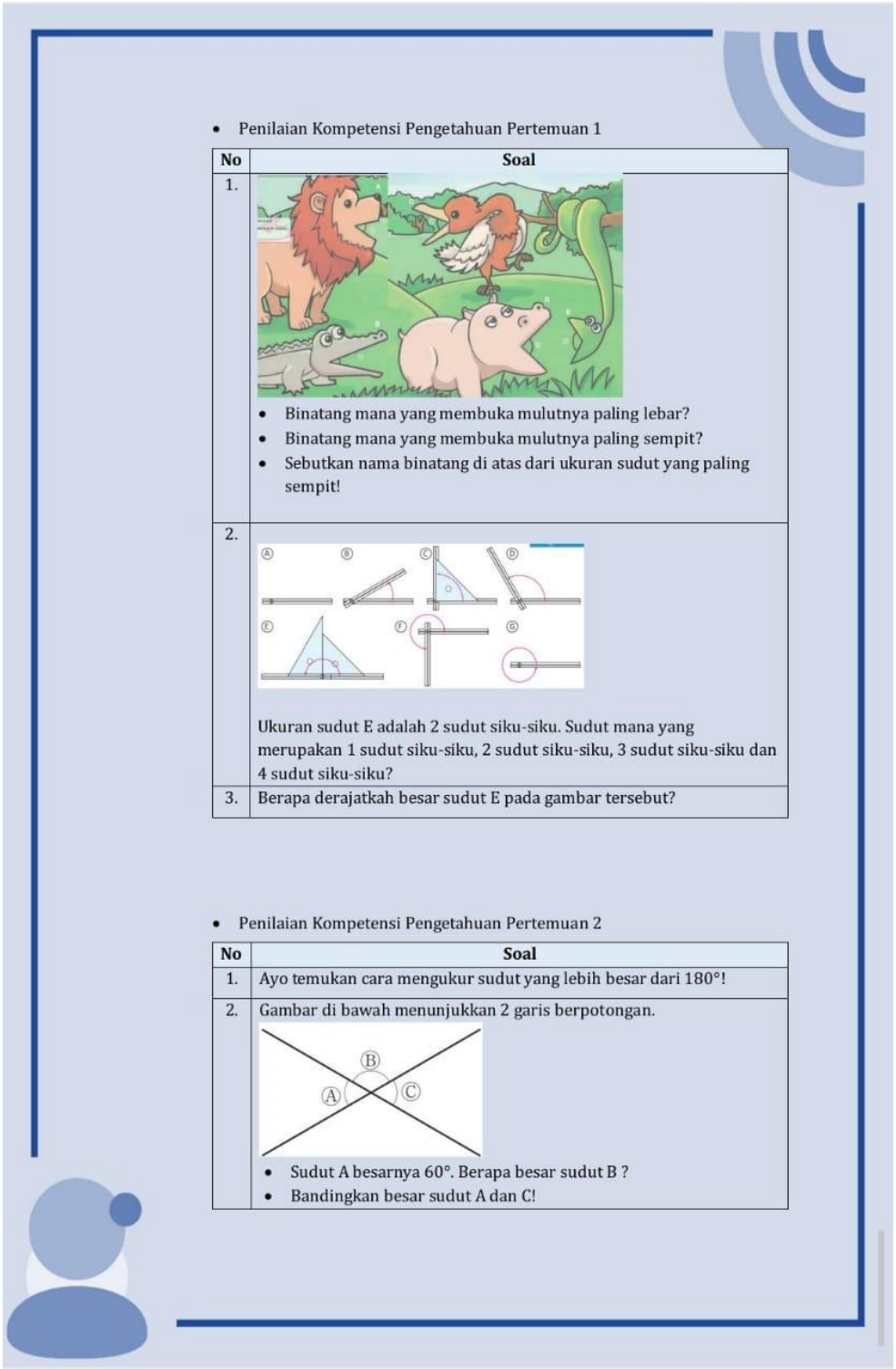
F. Asesmen

No	Jenis Asesmen	Bentuk Asesmen
1.	Diagnostik	• Pertanyaan pemantik tersebut di atas. • Tanya jawab sebagai tindak lanjut.
2.	Formatif	Observasi, Performa, dan Ulangan Harian
3.	Sumatif	Tertulis (*Essay*)

G. Kegiatan Remedial dan Pengayaan

1. Kegiatan remedial:
   Peserta didik yang hasil belajarnya belum mencapai target guru melakukan pengulangan materi dengan pendekatan yang lebih individual dan memberikan tugas individual tambahan untuk memperbaiki hasil belajar peserta didik yang bersangkutan.
2. Kegiatan pengayaan:
   Peserta didik yang daya tangkap dan daya kerjanya lebih dari peserta didik lain, guru memberikan kegiatan pengayaan yang lebih menantang dan memperkuat daya serapnya terhadap materi yang telah dipelajari.

Figure 4. Assessment and Enrichment Activities



- Penilaian Kompetensi Pengetahuan Pertemuan 1

No	Soal
1.	 • Binatang mana yang membuka mulutnya paling lebar? • Binatang mana yang membuka mulutnya paling sempit? • Sebutkan nama binatang di atas dari ukuran sudut yang paling sempit!
2.	 Ukuran sudut E adalah 2 sudut siku-siku. Sudut mana yang merupakan 1 sudut siku-siku, 2 sudut siku-siku, 3 sudut siku-siku dan 4 sudut siku-siku?
3.	Berapa derajatkah besar sudut E pada gambar tersebut?

- Penilaian Kompetensi Pengetahuan Pertemuan 2

No	Soal
1.	Ayo temukan cara mengukur sudut yang lebih besar dari 180°!
2.	Gambar di bawah menunjukkan 2 garis berpotongan. • Sudut A besarnya 60°. Berapa besar sudut B ? • Bandingkan besar sudut A dan C!

Figure 5. Student Worksheets

The core part of this mathematics teaching module consists of the first part, namely general module information, learning activities, and assessment in the form of LKPD, feedback, and follow-up. The learning activities in this developed teaching module are the application of the Problem Based Learning model which is integrated

with one of Taman Siswa's teachings, namely Tri-N. In the initial part, apperception or an opening is also included which is arranged with the aim that students can describe the material to be learned with knowledge known or experienced. The emphasis in this module is to repeat the previous material a little by giving a brief description of the previous material or giving some questions to help students remember the previous material, and provide an introduction to the new lesson by talking about the material to be learned with the environment or giving questions about concepts that students already know to develop/get a new concept. After perception, there are then learning activities that students must follow to gain knowledge of angular shapes. Learning activities begin with a problem that is closely related to students' daily lives. Learning activities are modeling or steps that students must follow in order to gain knowledge, so that learning objectives can be achieved. In learning activities, there are also Problem Based Learning learning steps based on Tri-N steps, so that students' mathematical reasoning skills can be facilitated.

The steps in problem-based learning according to Ismiyanti & Permatasari (2021) include the following:

1. Orientation of students to the problem

   The first steps include; Orienting students to problems, teachers explain learning objectives, give students problems, and motivate students to engage in problem-solving activities. The problems contained in learning activities and practice questions provide opportunities for students to achieve every indicator of mathematical reasoning. In the first stage this is an implementation of the Tri-N part *niteni* means to pay attention, observe, or listen. In this case, the student pays attention, makes observations, reads or listens carefully, feels, feels with his five senses.

2. Organizing students to learn

   The second step is to organize students to learn. In this step, the teacher helps students define and organize learning tasks by asking "what do you know from the above problems?". Then students can find out the information in the problem, know the mathematical facts in the problem, and know what is asked on the problem. This is contained in PBL based on the teachings of Tri-N. Tri-N part of *nambahi* which means developing, modifying, creating, adding, subtracting, improving, developing abilities, and expanding understanding.

3. Guiding individuals/groups

In this step students develop and present the work, the teacher assists students in solving problems, and students prepare the appropriate work (written report). The work is the result of students' thinking, so students must be able to solve mathematical problems through learning activities or experiences. In this step, students are also given the opportunity to communicate the results of their thoughts with other friends. This is in accordance with the teachings of the Tri-N *nirokke* section, it means imitating, imitating, implementing, doing something, and practicing in its own way.

4. Analyze and evaluate the problem-solving process

   The final step in Problem Based Learning is to analyze and evaluate the problem-solving process. Teachers have an important role and are tasked with analyzing and evaluating whether the problem solving done by students is correct or not by looking at the answer key / feedback. In addition, at this stage the teacher must also clarify if there are mistakes made by students. This is also in accordance with the teachings of the Tri-N section of *nambahi* which means to develop, modify, create, add, subtract, improve, develop abilities, and expand understanding.

DISCUSSIONS

This research succeeded in developing a mathematics teaching module with a Tri-N (Niteni, Nirokke, Nambahi) based problem-based learning model in Grade IV Elementary School. This is shown from the results of the assessment by these experts obtained Good and Very Good criteria, so that the Mathematics Module developed is valid and can be used at the next stage (product trials to students). This is in line with Maulidiana et al. (2021) research that the level of validity is important for the product before use. The results of this validity can also be concluded that the mathematics module developed can facilitate students' mathematical reasoning abilities.

CONCLUSION

This research succeeded in developing a mathematics teaching module with a problem-based learning model based on *Tri-N (Niteni, Nirokke, Nambahi)* in Grade IV Elementary School for reasoning, research development (Research &Development) with a PPE development model consisting of three stages, namely Planning, Production, and Evaluation. Based on the results of validation by material and media experts, the module is said to be valid with an average actual score of 98.5 with Good

criteria and 51.7 with Very Good criteria. The results of this study are expected to provide benefits for students in learning to improve mathematical reasoning. Researchers only develop mathematics modules to test validity, so further research is needed to conduct trials to find out the quality of this mathematics module product.

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