

Development of Mathematics Teaching Materials Based on the Merdeka Curriculum in Vocational High Schools

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Corresponding author: Reni Dwi Susanti renidwi@umm.ac.id	Abstract Effective learning is facilitated in large part by teaching modules. Teaching modules of the Merdeka Curriculum serve as useful manuals for educators as they prepare, carry out, and assess their lessons. The goal of this project is to provide teaching modules for mathematics that complement the Merdeka Curriculum's features in vocational high schools (SMK). Teachers of mathematics at SMK participated. Based on instructor input and expert assessment, the created module was determined to be useful and suitable for usage. Comprehensive elements of the training include contextually applicable Pancasila student profiles and prior capabilities. Essential questions, worthwhile learning activities, and comprehensive assessments that include diagnostic, formative, and summative evaluations are all included in this Problem-Based Learning (PBL) method. There are other resources for enrichment and remediation. A high degree of acceptability is shown by the average effectiveness score of 84.625% obtained from teacher replies. It is anticipated that this module will assist educators in carrying out contextualized, relevant learning that is in line with the objectives of the Merdeka Curriculum.
Keywords: Development; Teaching Materials; Independent Curriculum	

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INTRODUCTION

Mathematics is a compulsory subject that must be taken at all levels of education (Kamarullah, 2017). This is because learning mathematics can train thinking skills and also serve as a foundation for development in other fields (Simbolon et al., 2020). Furthermore, Firma (2010) stated that learning mathematics can train individuals to be meticulous, think logically, be honest, consistent, and hardworking. In reality, though, math lessons in vocational schools (SMK) frequently don't relate to students' practical disciplines and lack contextual significance. Students find it challenging to comprehend how mathematical ideas relate to their fields of expertise because of this imbalance. In actuality, the Merdeka Curriculum's emphasis on numeracy literacy promotes the contextualization of mathematics and its connection to students' real-world and professional circumstances.

The Merdeka Curriculum is the latest curriculum in Indonesia, developed as a continuation of the previous 2013 Curriculum (Khoirurrijal et al., 2022). It is implemented across all levels of education. The curriculum aims to enhance the

quality and competency of Indonesia's human resources (Vhalery et al., 2022). It places a strong emphasis on key competences, allows for flexibility in the design of learning, and views instructors as learning facilitators. The teaching module is one of the primary teaching resources in the Merdeka Curriculum. Teaching modules are organized manuals that teachers may use directly. They contain basic information, essential teaching elements, and appendices like student worksheets and learning tools. In this curriculum, the government has formulated a framework that aligns learning with the characteristics of learners and their achievement levels (Setiawan et al., 2022). The Merdeka Curriculum continues the principles of the 2013 Curriculum. It is holistic and competency-based rather than content-based, meaning the curriculum is structured according to the competencies to be developed in students rather than the breadth of the material taught. The focus is on what students can do with the material and its relevance to real-life situations.

However, in its implementation, the curriculum brings significant changes for teachers and school management, both administratively and pedagogically. The essence of the Merdeka Curriculum is to deepen the competencies of teachers and students in innovating and improving the quality of learning individually (Maulinda, 2022). Several key changes are introduced in the Merdeka Curriculum, including a more flexible curriculum structure, focus on essential materials, utilization of various learning tools, and the integration of information technology. Among these components, learning tools play a crucial role in schools as they serve as materials and instruments in the teaching and learning process. One of the most frequently used learning tools in schools is teaching materials.

Teaching materials refer to any form of learning resources containing instructional content and are used to assist teachers in conducting classroom instruction (Nurdyansyah, 2018; Magdalena et al., 2020). These materials play a critical role as references for teachers during the learning process (Suprihatin & Manik, 2020; Henny I. Sitanggang, 2023). Therefore, developing teaching materials is one of the essential competencies that teachers must possess. Moreover, teaching materials should not be limited to traditional printed or digital resources. One type of teaching material that teachers can develop is a teaching module. Such modules can be created by teachers based on their instructional needs and tailored to the specific context of their classrooms (Salsabilla et al., 2023).

In practice, however, developing teaching modules requires specific skills from teachers. Many teachers encounter difficulties in preparing these modules, particularly under the current implementation of the Merdeka Curriculum. SMKN 1 Bandung Tulungagung is one such school experiencing challenges in developing teaching modules as part of the curriculum's implementation. This is largely due to the limited socialization and training opportunities available to the mathematics teachers at the school. The motivation for the service team's involvement stems from this issue, as one of the mathematics teachers at SMKN 1 Bandung Tulungagung expressed that preparing quality teaching modules significantly influences the delivery of instructional content to students. Moreover, it also enhances teachers' confidence in presenting material.

In order to address these issues, the aim of this study is to create Merdeka Curriculum-compliant math teaching modules specifically for vocational high school students. The modules incorporate context-relevant Pancasila student

profiles, incorporate assessment techniques in line with the Minimum Competency Assessment (Asesmen Kompetensi Minimum/AKM), and are made to mirror the subject-specific learning objectives of mathematics at SMK. It is anticipated that the creation of these modules would support more competency-based, contextualized math education in vocational institutions

RESEARCH METHOD

This research is a development study. The type of research used is Research and Development (R&D) with the DDDE development model, which stands for Decide, Design, Develop, and Evaluate (Putra et al., 2023). The research was conducted at SMKN 1 Bandung Tulungagung with mathematics teachers as the subjects. The object of this study is the development of mathematics teaching materials in the form of Modul Ajar (Teaching Modules) aligned with the Merdeka Curriculum.

The development activities carried out consist of the following stages:

1. Decide.

To ascertain the urgency and course of module development at this early stage, a requirements analysis was conducted. Curriculum-related needs, particularly the transition to the Merdeka Curriculum, and the preparedness and ability of the target users (teachers and students) were the two primary areas of attention for the analysis. Teachers of mathematics were interviewed and consulted in order to gather data. Lack of AKM-based assessment materials, poor teacher confidence in module preparation, and limited exposure to training on the Merdeka Curriculum were among the main conclusions.

2. Design.

During the design phase, the module's content and structure were planned. This involved choosing subjects that were pertinent to the workplace and figuring out learning objectives that matched the curriculum's Phase F. This stage's activities included: determining the fundamental elements of the module (appendices, core components, and general information), choosing Problem-Based Learning (PBL) as a good learning approach because it is compatible with real-world occupational issues, establishing learning goals in accordance with the Alur Tujuan Pembelajaran, or Learning Objective Flow, assembling references and educational materials (textbooks, instructor guides, and digital media) and Using design software and document formatting tools to organize the module's structure and format (e.g., Mendeley for references, Canva for covers)..

3. Develop.

During this phase, the teacher participants really developed the mathematics teaching module. After being assembled, draft modules were validated by experts. The modules were examined by two validators who are specialists in curriculum development and mathematical instruction. The courses' clarity, relevance, completeness, and conformity with curricular requirements were all enhanced through the use of feedback. The integration of previous skills, the Pancasila student profile's alignment with the material, the learning stages' compatibility with the PBL model, the creation of key questions, and the

comprehensiveness of the diagnostic, formative, and summative assessment tools were among the important features that were updated.

4. Evaluate.

The final stage involved evaluating the effectiveness of the developed modules through user feedback. A structured questionnaire was distributed to mathematics teachers at SMKN 1 Bandung Tulungagung to assess aspects such as content clarity, relevance to curriculum standards, instructional design, and usability. The data were analyzed descriptively to determine the perceived effectiveness of the modules.

Table 1. Effectiveness Questionnaire

No	Indicator
1	The design is complete
2	The design aligns with the teaching module format of the Merdeka Curriculum
3	The general information section includes at least: module identity, prior competencies, Pancasila student profile, facilities and infrastructure, target learners, and learning model
4	The core components include: learning objectives, guiding questions, meaningful understanding, learning steps, and assessment
5	The appendix includes at least: teaching materials, student worksheets, assessment tools, media, glossary, and bibliography
6	The teaching module is engaging
7	The font used is clear and readable
8	The language used is easy to understand

RESULTS AND DISCUSSION

The teaching material development program was carried out in Tulungagung, targeting mathematics teachers at SMKN 1 Bandung Tulungagung. The teaching material developed in this program is in the form of a Modul Ajar (Teaching Module). Through this activity, it is expected that teachers will be able to prepare their own teaching books, which serve as instructional resources to guide the delivery of learning materials to students.

Therefore, prior to the development of the teaching modules, a workshop and training session on the preparation of Modul Ajar within the Merdeka Curriculum framework was conducted. Additionally, this program includes mentoring sessions to assist teachers during the module development process, ensuring that the implementation proceeds effectively.

The results of the teaching module development for vocational mathematics based on the Merdeka Curriculum are as follows:

1. Decide

This initial stage involves defining the needs for development. To define these needs, it is necessary to analyze and gather information on the extent of development required. The Decide stage was conducted prior to the workshop activities. Several reasons were identified for the need to develop teaching modules at the school, as summarized show in Table 2.

Based on the needs analysis, it is evident that developing a teaching module for mathematics at the vocational school level within the Merdeka Curriculum framework is necessary.

Table 2. Results of Needs Analysis

No	Needs Analysis Results
1	National policy on implementing the Merdeka Curriculum in all schools
2	Most teachers have not received socialization on the curriculum implementation
3	Lack of information on how to prepare teaching modules
4	Low teacher creativity in developing teaching materials
5	Existing modules used in school are still based on the previous curriculum
6	Lack of knowledge regarding the preparation of AKM-based assessments

2. Design

The Design stage involves the planning and structuring of the teaching module. It began during the workshop, which was facilitated by an expert in developing Modul Ajar for the Merdeka Curriculum. During the workshop, joint identification was carried out with the participating teachers. Several steps were taken during this stage:

a. Analyzing Module Components in the Merdeka Curriculum

The first step involved identifying the mandatory components in a Modul Ajar, which include:

1) General Information

- a) Module identity
- b) Learning outcomes
- c) Profil Pelajar Pancasila
- d) Target learners

2) Core Components

- a) Learning objectives (aligned with the Alur Tujuan Pembelajaran)
- b) Meaningful understanding
- c) Guiding questions
- d) Learning model
- e) Learning activities (usually for one or more meetings)
- f) Assessments (including plans, instruments, and procedures for formative and summative assessment)

3) Appendices

Teaching materials such as readings, media, worksheets, videos, and relevant website links

b. Determining the Learning Outcomes

After identifying module components, the next step was defining the learning outcomes. As the participants are vocational school teachers, the targeted outcomes correspond to Phase F, which include:

"By the end of Phase F, students are expected to generalize the properties of exponential numbers (including fractional exponents), and apply arithmetic and geometric sequences and series, including problems related to simple and compound interest."

c. Preparing Source Books and Reference Materials

Teachers selected source materials including teacher handbooks, topic-specific textbooks for Phase F, and digital references available online to support content, media, and assessment development.

d. Identifying Learning Content

Teachers, during mentoring sessions, identified learning materials based on the targeted outcomes. The topics included: exponents, arithmetic and geometric sequences and series, simple and compound interest, systems of linear equations in three variables (SPLTV), systems of linear inequalities in three variables (SPtLTV).

e. Designing the Learning Model

Once content was identified, the teachers selected appropriate learning models. For this module, they chose Problem-Based Learning (PBL), utilizing discussion, questioning, and assignments/presentations.

f. Designing the Module Format

After defining the components, the teachers designed the layout and template of the teaching module. Templates were tailored to the school's characteristics. Mentoring also included training on using Canva for cover design, Mendeley for referencing, and Heading tools in document formatting.

g. Drafting the Teaching Module

The module draft includes the following structure:

Cover

Preface

Approval Page

Table of Contents

Chapter 1: Exponents

General Information

Core Components

Appendices

Glossary

References

Chapter 2: [e.g., Sequences and Series]

Chapter 3: [e.g., Interest and SPLTV]


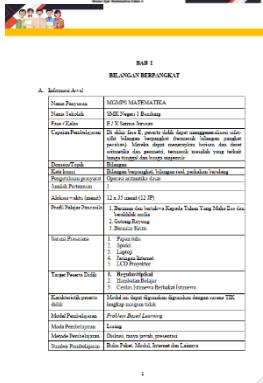
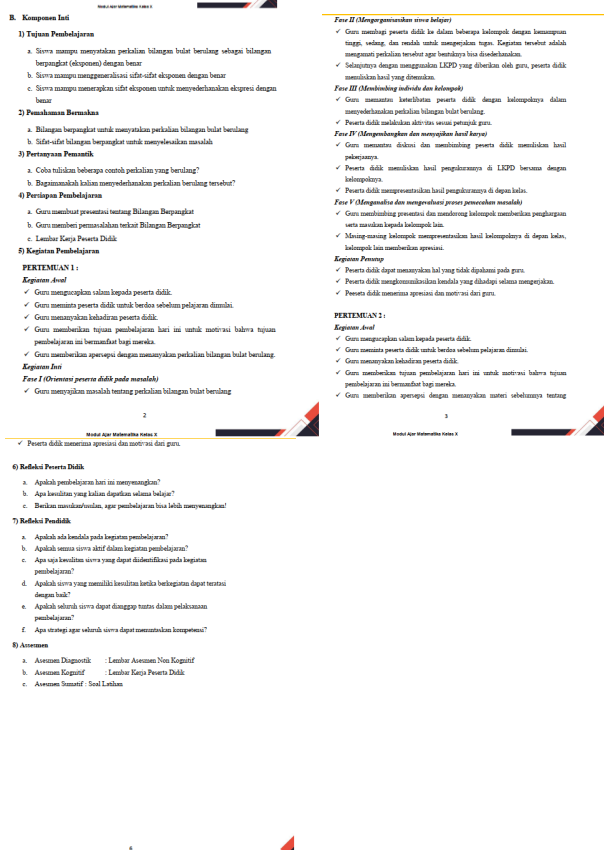
Closing

The content structure for Chapters 2, 3, and so on follows the same format as Chapter 1.

3. Develop

The Develop stage began with actual module development, carried out by the teacher participants. It involved producing the module from cover design to the final section. Below is an overview of the results of the mathematics module development process:

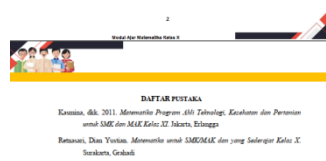
Table 3. Results of the Developed Mathematics Module

No	Components	Development result
1	Cover	
2	Preliminary Information	
3	Core Components	

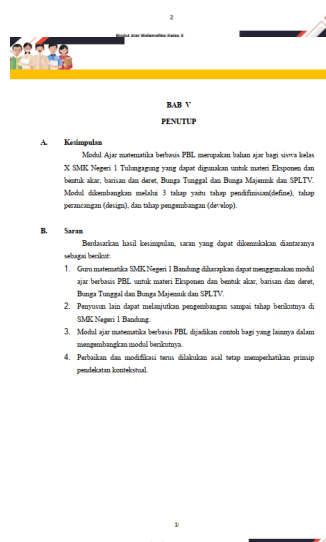
5 Glossary



6 References



7 Closing



In addition, at this stage, validation by experts was also conducted with the aim of evaluating the content of the module to ensure that it is of high quality and feasible for use. Validation was carried out by two validators who are experts in the field of instructional material development and mathematics curriculum. The result above shows the appearance of the module that has undergone

validation. The following are suggestions and feedback on the module development provided by the validators:

- a. Include prior competencies in the module identity in the form of statements outlining the competencies to be achieved after studying the content of the module.
- b. Align the Pancasila student profile with the context of the learning material.
- c. Choose a learning model that is relevant to the material being delivered.
- d. Learning objectives should at least include the content flow and learning goals.
- e. Include essential questions that are aligned with the context of the material.
- f. Learning activities must be consistent with the selected learning model.
- g. Assessments should include diagnostic, formative, and summative assessments and be attached to the module.
- h. Remedial and enrichment materials may be added and included in the appendices.
- i. For mathematical texts, please use Microsoft Equation for proper formatting.

With the feedback and suggestions provided by the validators, the teaching module is now ready for use and dissemination.

4. Evaluate

This stage involves the evaluation process. To assess the effectiveness of the teaching module, a comprehension trial was conducted with mathematics teachers at the school. The results of the teachers' responses to the content of the module are presented below:

Table 4. Analysis of Questionnaire Responses

No	Indicator	Percentage
1	Complete design	87%
2	Design aligns with the teaching module format of the Merdeka Curriculum	82%
3	General information includes module identity, prior competencies, Pancasila student profile, facilities and infrastructure, target students, and learning model	85%
4	Core components include learning objectives, essential questions, meaningful understanding, learning steps, and assessment	86%
5	Appendices include teaching materials, student worksheets, assessments, media, glossary, and references	80%
6	The module is engaging	86%
7	The font used is clear and readable	84%
8	The language used is easy to understand	87%
Average Score		84.625%

Based on the results of the response questionnaire regarding the effectiveness of the mathematics teaching module aligned with the Merdeka Curriculum, the average score was 84.625%. No respondents gave a score below 80%. Therefore, it can be concluded that the teaching module meets the criteria

of the Merdeka Curriculum and is appropriate to be used as a learning guide in vocational high schools (SMK).

From the results of this module development, it can be concluded that in designing or developing a teaching module in accordance with the Merdeka Curriculum, attention must be given to several key components that must be included in the module—specifically within the general information, core components, and appendices. For example, the inclusion of prior competencies and the Pancasila student profile are distinguishing features of modules developed under the Merdeka Curriculum. Furthermore, in the core components, the sequence of learning activities should apply problem-based learning and include essential questions and meaningful understanding following the learning objectives. In the appendices, the module should be supplemented with assessments. These assessments must cover diagnostic, formative, and summative types. When preparing assessments, it is important to follow the structure of question development by referring to the Minimum Competency Assessment (Asesmen Kompetensi Minimum or AKM), which must take into account both content and context elements.

With this teaching module, it is expected that teachers can act as facilitators in the learning process and foster meaningful learning experiences that align with the Pancasila student profile (Siloto, 2023). In addition, Maulinda (2022) stated that teaching modules in the Merdeka Curriculum serve as alternatives to lesson plans (RPP). These modules have diverse formats, encompassing learning content, teaching methods, and evaluation, and are systematically designed to achieve the intended learning outcomes. Furthermore, considering the distinctive feature of the Merdeka Curriculum which includes minimum competency assessment criteria, each module is designed using accessible language, concrete examples, and challenging exercises (Vedianty & Arif, 2023).

CONCLUSION

General information, main components, and appendices are among the crucial elements that must be carefully considered while creating a teaching module that is in line with the Merdeka Curriculum. The module's quality and usability have been confirmed by validation by specialists in mathematics education and instructional material production. Prior competences, pertinent Pancasila student profiles, suitable learning models, key questions, significant learning objectives, and thorough assessment techniques encompassing diagnostic, formative, and summative elements were all stressed in validators' feedback.

With an average score of 84.625%, the findings of the teacher response analysis show that the module is well-liked, pertinent, and skillfully created in accordance with the Merdeka Curriculum's tenets. This implies that the module may function as a trustworthy manual for teaching mathematics in vocational schools (SMK).

In conclusion, a well-designed Merdeka Curriculum teaching module should emphasize critical skills, use problem-based learning strategies, and include assessment tools that complement the Minimum Competency Assessment framework. By doing this, the module helps to realize the Pancasila student profile

in the classroom while simultaneously promoting meaningful and student-centered learning.

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