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Analysis of Merdeka Curriculum-based Electronic Module Needs for Physics Learning Phase F

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A B S T R A C T

This study aims to define the need for Merdeka curriculum-based electronic modules for physics learning phase F. This research uses a qualitative approach with a descriptive research type. Data was collected through interviews, questionnaires, and observation. The results showed that teachers and students used technology in learning physics. They realize that using teaching materials such as electronic modules based on the Merdeka curriculum is essential. However, the number of physics teaching materials is still limited, especially the electronic modules for physics learning phase F. Phase F teachers and students need physics teaching materials based on a Merdeka curriculum. Some students who have not met the minimum learning outcomes try to find these teaching materials through tutoring outside of school. Indicators of Merdeka curriculum-based teaching materials include: 1) teaching materials have process skill syntax, 2) learning is structured using the Understanding by Design approach, and 3) teaching materials have components that support strengthening the Profil Pelajar Pancasila in learning. This is by the mandate of learning in the Merdeka curriculum. The development of physics teaching materials needs to be done to achieve the objectives of learning physics in the Merdeka curriculum.

1. Introduction

The COVID-19 pandemic has spread in Indonesia since early 2020. During the COVID-19 pandemic, schools implemented distance learning from home. Online learning includes physics learning (Purwanto et al., 2020). This formed new habits for teachers and students after the COVID-19 pandemic, namely the habit of using technology in learning (Ekawati & Prastyo, 2022). In addition, teachers are required to develop meaningful physics learning strategies (Ramadayanty et al., 2021). Teachers need to have TPACK skills in facilitating online learning.

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TPACK explains teachers' technological, pedagogical, and knowledge abilities (Mayer & Girwidz, 2019). In online learning, teachers are not optimal in providing stimulus. Teachers can less develop meaningful physics learning strategies (Ekawati & Prastyo, 2022). So that students feel bored learning. This causes learning loss to occur gradually.

Learning in Indonesia has experienced loss in the last decades, including learning physics as a science (Anggraena, Felicia, et al., 2022; Bella, 2023). The PISA results show that the science skill scores of Indonesian students have not increased significantly in the last 20 years (OECD, 2019). The COVID-19 pandemic exacerbated this. The government seeks solutions to overcome learning loss. One is by launching a new curriculum for learning a new paradigm, namely the Merdeka curriculum. Educational institutions are encouraged to continue developing effective digital media to support learning activities (Hanum, 2023).

The Merdeka curriculum is a new paradigm learning tool or system that is flexible and based on character values. Character values in the Merdeka curriculum are manifested by strengthening the Profil Pelajar Pancasila (Anggraena, Felicia, et al., 2022). The Merdeka curriculum will begin to be implemented in 2021 at Mobilizing Schools. The Merdeka curriculum emphasizes the uniqueness of students and the meaningfulness of learning, including learning physics (Jojor & Sihotang, 2022). Physics learning is included in the Merdeka curriculum structure for intracurricular learning. Learning physics in the Merdeka curriculum emphasizes two elements: understanding physics and process skills (Anggraena, Ginanto, et al., 2022; Afinda, 2023). Physics learning needs to be designed according to the Merdeka curriculum concept.

On the other hand, learning physics is scary for some students. This happened because physics is known as an abstract and challenging subject. One of the physics materials that students find difficult is momentum and impulse material. Students often experience misconceptions about momentum and impulse material. Students experience difficulties solving problems, understanding concepts, using equations, analyzing images, and concluding concepts (Azizah et al., 2015). The existence of physics teaching materials can overcome these difficulties.

Teaching materials are a collection of teaching materials that are systematically arranged according to the applicable curriculum (Magdalena et al., 2020). The current learning curriculum is the Merdeka curriculum. Physics learning design needs to adapt to the concept of a Merdeka curriculum, including physics teaching materials such as electronic modules. This is done so that learning outcomes are fulfilled. However, the availability of teaching materials based on the Merdeka curriculum is still a problem, including teaching materials for physics learning phase F. The development of the times and technology has increased the enthusiasm of teachers and students to use digital teaching materials (Jamun, 2018). One of the digital teaching materials that are often used for learning is an electronic module.

The electronic module is an innovative teaching material that contains material, teaching methods, and evaluation. Electronic modules are teaching materials needed at this time, especially learning physics phase F. Studies show that teachers and students need electronic modules for learning (Nugroho Yuliono et al., 2018). Physics learning has not utilized electronic modules in the applicable curriculum (Afriyanti et al., 2021). Another study revealed that electronic modules must be prepared based on the applicable curriculum (Sumarmi et al., 2021). Electronic modules are today's alternative teaching materials (Serevina & Sari, 2018). This is based on the times changing conventional learning into digital-based modern learning.

Based on the problems above, this study aims to define the need for Merdeka curriculum-based electronic modules for physics learning phase F. The teaching materials referred to in this study focus on the electronic module on momentum and impulse material. The research was conducted after the changes in the education curriculum.

2. Methodology

The approach used in this research is qualitative with a descriptive research type. The definition is carried out according to the analysis phase in the definition stage of the 4D development model. The phases in the defining stage consist of front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives (Thiagarajan et al., 1974). The research was conducted at SMA Negeri 3 Surakarta from September 2022 to March 2023. SMA Negeri 3 Surakarta was chosen as the research location because this school is a Sekolah Penggerak. Sekolah Penggerak is a pilot school implementing a Merdeka curriculum earlier than other schools (Prastyo et al., 2022). The subjects of this study were three physics teachers and students from phase F. The research techniques used were questionnaires, interviews, and observation. Data on the need for electronic modules as physics teaching materials were collected through questionnaires, questions, and checklists. The instruments used have been discussed and validated by experts before being used for research. Research data analysis was carried out descriptively.

3. Results and Discussion

The results of this study were obtained from data from interviews, questionnaires, and observations. The interview informants were three physics teachers. The interview was conducted in March 2023 face-to-face. The results of interviews with informants are presented in Table 1.

Table 1. Data from Interviews with Teachers

No	Question	Response
1	Do you use teaching materials such as	1. No 2. No. But I use the Cambridge curriculum as an

	electronic modules in the Merdeka curriculum-based learning process in class?		operational curriculum 3. No
2	How important is using electronic module teaching materials based on the Merdeka curriculum in physics learning?	1. 2. 3.	Important. The use of teaching materials by the curriculum is a means to achieving educational goals Important. Education must follow the development of science and technology. Important. But the Merdeka curriculum-based physics teaching materials are still limited.
3	Have you taught the prerequisite concepts of momentum and impulse material?	1. 2. 3.	Done. All prerequisite concepts of momentum and impulse material have been taught Done. Such as Newton's second law, vectors, and energy Done
4	In your opinion, how to create meaningful learning experiences for students through electronic module teaching materials?	1. 2. 3.	Electronic modules are arranged with meaningful learning strategies. The learning approach used is Understanding by Design or UbD. Physics learning uses a Merdeka curriculum-based electronic module. Teaching materials are arranged based on stages in process skills. The electronic module has an attractive appearance for students to learn
5	How vital are exercises, portfolios, and projects to deepen physics material and strengthen Profil Pelajar Pancasila?	1. 2. 3.	Important. Practice questions, portfolios, and projects can deepen understanding of physics based on Profil Pelajar Pancasila Important. The assignment implements the six dimensions of the Profil Pelajar Pancasila Important. Strengthening Profil Pelajar Pancasila through assignments is carried out in learning, especially in projects
6	Based on learning outcomes and the flow of learning objectives in the Merdeka curriculum, what are the physics concepts that need to be mastered by students in the material of momentum and impulse?	1. 2. 3.	Impulse, momentum, momentum-impulse theorem, the law of conservation of momentum, and collision Momentum, impulse, the relationship between momentum and impulse, the law of conservation of momentum, and collision Momentum, impulse, momentum-impulse theorem, the law of conservation of momentum, and collision
7	What minimum learning outcomes do students need to achieve in learning momentum and impulse material?	1. 2. 3.	Students reach a minimum cognitive level of C3 In terms of learning objectives, students are expected to be able to apply the concepts of momentum and impulse in everyday life Application
8	Are you interested in using smartphone-based teaching materials such as electronic modules?	1. 2. 3.	Yes Interested Interested
9	If you are given teaching materials in the form of electronic modules, what criteria do you expect to have in	1. 2.	The electronic module has an attractive appearance, so students do not get bored learning The electronic module is structured for physics learning based on the Merdeka curriculum by strengthening the Profil Pelajar Pancasila

	their development?	3. The electronic module meets the criteria for suitable teaching materials and is relevant to the Merdeka curriculum

The results of interviews with three informants indicated that physics learning had not used Merdeka curriculum-based teaching materials. This is because the number of physics teaching materials based on the Merdeka curriculum is still limited, especially the electronic modules. Teachers need teaching materials prepared with meaningful and up-to-date learning strategies, namely physics teaching materials based on a Merdeka curriculum. Merdeka curriculum-based teaching materials are arranged based on the syntax of process skills. Physics learning is designed with the Understanding by Design (UbD) approach. Physics learning based on the Merdeka curriculum emphasizes strengthening the Profil Pelajar Pancasila. Assignments such as practice questions, portfolios, and projects are essential in strengthening Profil Pelajar Pancasila. The results of these interviews show similarities with the results of the questionnaire distributed to students.

The questionnaire was distributed to 63 informants from 21 December 2022 to 15 March 2023. The questionnaire was prepared based on the phases in the interview questions list. Questionnaire result data is presented in Table 2.

Table 2. List of Questions and Student Responses to the Questionnaire

No	Question	Alternative Answers	%
1	Do you have a smartphone?	Yes	100
		No	0
2	How often do you use your smartphone in a day?	Less than 1 hour	1.6
		1 – 3 hours	15.9
		3 – 6 hours	25.4
		More than 6 hours	57.1
3	How often do you watch physics learning videos using your smartphone in a week?	Less than 1 hour	52.4
		1 – 3 hours	39.7
		3 – 6 hours	7.9
		More than 6 hours	0
4	How often do you read physics teaching materials using a smartphone weekly?	Less than 1 hour	54
		1 – 3 hours	36.5
		3 – 6 hours	9.5
		More than 6 hours	0
5	Do you use the school's internet network (such as WiFi or WLAN) in learning?	Yes	82.5
		No	17.5
6	Do you have electronic module teaching materials as a source of independent learning?	Yes	61.9
		No	38.1
7	Are electronic module teaching materials suitable for learning a new paradigm in the Merdeka curriculum?	Yes	54
		No	46
8	Do physics teachers use electronic module teaching materials for the learning process in class?	Yes	0
		No	100
9	Is the use of a smartphone an essential thing as learning tool?	Yes	98.4
		No	1.6

10	In your opinion, how important is the use of electronic module teaching materials in physics learning?	Very important	25.4
		Important	66.7
		Not too important	7.9
		Not important	0
11	How easily do you think the Momentum and Impulse material can be mastered?	Very easy	0
		Easy	46
		Difficult	44.4
		Very difficult	9.5
12	Are you used to using smartphones to access learning resources, especially e-modules?	Already accustomed	81
		Not familiar	19
13	Mark the learning style that suits you! (You can select more than one option)	It is easier to remember things seen or read	61.9
			41.3
		It is easier to remember things heard	79.4
		It is easier to remember things that were done	
14	What form of assignment allows you to study physics material? (You can select more than one option)	Exercises	98.4
		Portfolio (such as summaries and posters)	85.8
		Project	76.2
15	Bookmark the material topics you have mastered from the Momentum and Impulse Chapter! (You can select more than one option)	Momentum	69.8
		Impulse	65.1
		The momentum-impulse theorem	54
		The law of conservation of momentum	42.9
		Collision	39.7
		There is no material topic that I mastered from this chapter	17.5
16	Do you know the learning outcomes of the Momentum and Impulse chapter?	Yes	65.1
		No	34.9
17	Is the electronic module for the momentum and impulse chapter currently circulating by the learning outcomes of the Merdeka curriculum phase F?	Yes	15.9
		No	84.1
18	Can you apply the concept of momentum and impulse to everyday problems?	Yes	54
		No	46
19	Are you curious and trying to learn to use smartphone-based modules?	Yes	92.1
		No	7.9
20	Are you interested in using teaching materials such as electronic modules?	Yes	88.9
		No	11.1

The questionnaire results show that all students have smartphones and use them daily to study. The use of smartphones is essential in learning in the digital era. The school provides an internet connection to support the learning process. Students often use smartphones and take advantage of the internet connection provided by the school to access physics learning videos for physics teaching materials. The use of teaching materials such as electronic modules is essential in today's physics learning. However, some students experience limitations in accessing the Merdeka curriculum-based physics electronic module. Students need to put more effort into learning physics material, one of which is by looking for momentum and impulse teaching materials based on the Merdeka curriculum.

Students are interested in using physics teaching materials such as electronic modules. Students expect electronic modules that present material in a clear, attractive appearance and language that is easy to understand. Students are curious and want to try learning to use electronic modules for physics learning on momentum and impulse material.

Momentum and impulse is one of the teaching materials in physics learning phase F. The majority of students have difficulty mastering the material. Students find learning momentum and impulse material easy through real experience or action. This is to the number of students who have a kinesthetic learning style. In momentum and impulse material, the concept that is easiest for students to master is the concept of momentum. While the concept that is most difficult for students to master is the concept of collision. Students revealed that practice questions, portfolio assignments, and project assignments were essential in learning physics on momentum and impulse material. Students know the achievements of physics learning in phase F, especially the learning objectives on momentum and impulse material. However, students have not reached the minimum level of the learning objectives. Observational data reinforce these things.

Observations were made on 12 September 2022 – 15 November 2022 on 72 students as informants. Observations were made during the physics learning process from chapter 4 to chapter 7. The observation results showed that students always brought smartphones to school. Students use smartphones to read physics material and watch physics learning videos with the help of an internet connection. The school provides WiFi and WLAN internet connection facilities as learning tools so students can access knowledge widely. This shows that the school and students realize that using technology such as smartphones is very useful in today's digital learning, including in learning physics.

The results of observations on physics learning based on the Merdeka curriculum phase F the teacher uses learning syntax based on flow in process skills. The syntax for learning physics in phase F includes: 1) observing, 2) questioning and predicting, 3) planning and conducting investigations, 4) processing and analyzing data and information; 5) creating; 6) evaluating and reflecting; and 7) communicating results. The learning syntax is applied informatively without teaching materials. Strengthening the Profil Pelajar Pancasila has not been optimally implemented in physics learning phase F. There is no teaching material based on a Merdeka curriculum, especially for phase F. The school library has not yet provided physics teaching materials based on a Merdeka curriculum. In addition, observations at several online shops show that the number of teaching materials for physics modules is still limited, including physics teaching materials for phase F. This shows that teaching materials such as modules for physics learning in phase F are rarely developed. The results of observations on using Merdeka curriculum-based physics teaching materials in class are shown in Table 3.

Table 3. Checklist of Observations on the use of Physics Teaching Materials in Phase F

Observed Aspects	**Many informants show performance**			
	Learning physics chapter 4	**Learning physics chapter 5**	**Learning physics chapter 6**	**Learning physics chapter 7**
Module use	There are not any	There are not any	There are not any	There are not any
Book use	There are not any	There are not any	There are not any	There are not any
Use of student worksheets	72 of 72 informants	36 of 72 informants	72 of 72 informants	There are not any
Use of other teaching materials	There are not any	There are not any	There are not any	There are not any

Based on table 3, it can be understood that students and teachers have not utilized Merdeka curriculum-based teaching materials in any physics learning materials in the classroom. The limitations of Merdeka curriculum-based physics teaching materials resulted in students' needs for learning tools not being met. So the learning outcomes of physics based on the Merdeka curriculum are not optimal. Learning outcomes on momentum and impulse material show that most students have not reached the minimum level of physics learning achievements in phase F. Some try to fulfill learning outcomes by following tutoring outside of school. Tutoring provides physics teaching materials such as books and electronic modules based on the Merdeka curriculum to help students achieve minimal learning outcomes. Students often use the electronic module independently at school. This shows that using physics teaching materials that keep up with the times is very important for students, one of which is the electronic module.

Based on the description of the research data, it is understood that the number of teaching materials based on the Merdeka curriculum for physics learning phase F is still limited, including teaching materials such as electronic modules. Physics learning in phase F still utilizes teaching materials such as printed books arranged based on other curricula. The teaching materials are less interactive and varied, making students feel bored learning physics. Learners need teaching materials such as learning videos, text, images, animations, and simulations. Electronic modules for physics learning phase F need to be developed so that physics learning is more interactive and not boring. So that students can learn physics independently and classically. New habits in learning emerged after the pandemic.

Studies reveal that the COVID-19 pandemic has led to new habits in smartphone-based learning, such as using electronic modules (Wulandari et al., 2022)—studies on the need for electronic modules for learning support this. Teachers and students need electronic modules as alternative teaching materials that are easy and practical (Puspitasari et al., 2022). The use of electronic modules changes students' thinking about complex physics subjects to be fun (Wulandari et al., 2022). Electronic modules can be used interactively through video, image, animation, and simulation features (Saputri et al., 2022). Electronic modules arranged systematically can help students understand concepts. Studies show

electronic modules can improve student learning outcomes (Nugroho Yuliono et al., 2018). Electronic modules can be used for independent learning without or without teacher guidance (Prastowo, 2012). Other studies reveal that students like teaching materials designed in a multi-representational manner (Resita & Ertikanto, 2018). Students like electronic modules to study physics because they can present images, videos, animations, hyperlinks, and simulations. Students like experience-based physics learning in everyday life (Rahmawati et al., 2021). This is by the mandate of the Merdeka curriculum that physics learning design needs to develop students' process skills through the latest phenomena that occur in everyday life.

Electronic modules can be structured by empowering character values (Ezz, 2023; Sani et al., 2021). Based on this, electronic modules for physics learning based on the Merdeka curriculum can also be arranged by strengthening character values. Character strengthening in the Merdeka curriculum is carried out by implementing Profil Pelajar Pancasila. Developing electronic modules is expected to fulfill the TPACK aspects of physics learning. TPACK-based learning needs to provide a stimulus to increase learning motivation (Ekawati & Prastyo, 2022). One of the implementations of TPACK learning is the development of Merdeka curriculum-based electronic modules for physics learning. The development of a Merdeka curriculum-based electronic module is expected to be able to keep up with developments in the world of education and learning based on TPACK, especially in physics learning phase F.

4. Conclusion

Based on the results of research and discussion, it can be understood that teachers and students use technology in learning physics. Teachers and students need electronic modules as teaching materials based on the Merdeka curriculum for physics learning phase F. The number of Merdeka curriculum-based electronic modules for learning physics in phase F is still limited, including electronic physics modules on momentum and impulse material. Procurement of electronic modules is essential in learning physics in the digital era. Physics learning achievements can be fulfilled through the use of electronic modules. The electronic module includes video, audio, images, animation, simulation, text, and discussion space. These features are used optimally according to the characteristics of students, learning concepts, assignments, and learning objectives. The development of physics teaching materials such as electronic modules based on the Merdeka curriculum is needed to overcome the current limitations of Merdeka curriculum-based teaching materials, especially electronic modules for physics learning phase F. Indicators of Merdeka curriculum-based teaching materials include: 1) physics teaching materials have process skill syntax, 2) learning is structured using the Understanding by Design approach, and 3) teaching materials have components that support strengthening the Profil Pelajar Pancasila in the learning process. This is by the mandate of learning physics in the Merdeka curriculum. Using electronic modules for physics learning is a form of TPACK implementation. The development of physics teaching

materials based on the Merdeka curriculum emphasizes the pedagogic aspects of TPACK. So that the development of electronic modules needs to adjust the physics learning design in the current curriculum, namely the Merdeka curriculum. The electronic module for physics learning based on the Merdeka curriculum is structured based on process skills syntax. In addition, developing electronic modules for learning physics embodies the technological aspects and learning content at TPACK following the development of science and technology.

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