Development of a Physicist-Muslim comic for Newton's law of motion: a needs analysis from teachers' and students' perspectives

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Newton's Law of Motion is one of the challenging concepts that require the use of various types of resources as teaching and learning aids to improve students' understanding of the concept. Hence, this research was conducted to analyze the need for developing an al-Quran integrated learning aid in the form of a comic for the Newton's Law of Motion concept from the perspectives of teachers and students. The research design employed a survey study, utilizing teacher and student questionnaires as the primary research instruments. A total of 20 physics teachers and 384 senior high school students in West Sumatra were selected using a simple random sampling technique as the sample of this research. The data were analyzed using descriptive statistics. The findings indicated that 65% teachers and 72.9% students agreed that Newton's Law of Motion is a difficult concept to teach and learn. The findings also showed that only 55% of teachers employed Quranic verses to teach Physics concepts, but no teachers used educational comics in their teaching and learning sessions. However, 79.4% of students assumed that the educational comic could help them enhance their understanding of the Physics concept. In addition, the findings show that 121 students have the Visual-Auditory-Kinesthetic (VAK) learning style as their most dominant learning preference; meanwhile, 95% of the learning resources only facilitate the visual learning style. Additionally, 90.6% of students state the need for the integration of the Al-Quran, which highlights the relevance of Newton's Law. In conclusion, there is a need to develop an Al-Quran integrated learning resource in the form of a comic for the Newton's Law of Motion concept, targeting the VAK learning style. The learning resource is designed to enhance conceptual understanding among students with diverse learning styles.

Keywords: Learning styles; comic; Newton's Law of Motion; teachers' perspective; students' perspective.

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1. Introduction

Physics is a branch of science that studies physical phenomena through theory, observation, and experimentation [1]. In the physics learning process, students are trained to conduct simple research on natural phenomena. Students learn to identify a problem, formulate a hypothesis, design a simple experiment, conduct the experiment, analyze data, draw conclusions, and communicate experimental results in writing and orally. However, abstract physics concepts often make it difficult for students to connect these abstract ideas to real-world phenomena. Many students struggle to understand physics concepts because they have to memorize numerous formulas [2]. In addition, students' ability to solve physics problems is generally low. This is because students tend to memorize formulas without understanding the underlying concepts or being able to analyze physics problems effectively. This is a challenge that can affect the effectiveness of physics learning.

Physics learning in Indonesia currently follows the Merdeka curriculum, which focuses on two main aspects: conceptual understanding and process skills. Based on the Educational Standards, Curriculum and Assessment Board Ministry of Education, Culture, Research and Technology of the Republic of Indonesia, this curriculum has a characteristic known as the Profil Pelajar Pancasila (Pancasila Student Profile), containing elements of faith and devotion to God Almighty as well as noble morals, global diversity, cooperation, independence, critical reasoning, and creativity [3]. This demonstrates the connection between science and religious values, which can motivate students to improve in all aspects of life.

The Organization for Economic Cooperation and Development (OECD) consistently assesses the quality of a country's education through the Program for International Student Assessment (PISA), evaluating student achievement every three years. PISA assessments focus on literacy in reading, mathematics, and science. Indonesian PISA scores in science from 2006 to 2022 are shown in Fig. 1.

Figure 1 shows the fluctuation of Indonesia's PISA scores in science over the last six PISA periods. This data indicates that the quality of science education in Indonesia remains relatively low. Although a notable improvement was recorded in 2015, the scores declined again in 2018 and continued to drop in 2022. The science score in the 2022 PISA assessment was 383, nearly identical to the score obtained in 2012. This

FIGURE 1. Indonesia's PISA Scores in Science (source: OECD, PISA).

decline is believed to have been influenced by the disruptions caused by the COVID-19 pandemic, which significantly hindered teaching and learning activities, resulting in reduced effectiveness in students' conceptual understanding. According to PISA, Indonesian students show inadequate literacy in several domains, including interpreting information and theories, analyzing and solving complex problems, using scientific tools and procedures, and conducting investigations. Science learning in schools encompasses disciplines such as physics, chemistry, and biology, and the delivery can be carried out either integratively or as separate subject areas.

Physics education in the 21st century aims to foster students' reasoning abilities, critical thinking abilities, and deep understanding [4, 5]. To achieve these goals, the emphasis is placed on building conceptual understanding and developing students' problem-solving skills. This approach contrasts with traditional physics instruction, which often prioritizes procedural problem-solving exercises and encourages rote memorization of formulas rather than fostering meaningful understanding.

This traditional approach remains prevalent in the Indonesian education system. According to data from the Indonesian Ministry of Education's National Examination (UN) results, available at https://hasilun.pusmenjar.kemdikbud.go.id/, physics consistently ranks as the lowest-performing subject compared to chemistry and biology. Physics National Examination results data in West Sumatra, Indonesia, for 2015-2019 are presented in Table I.

The average score on the national physics examination in West Sumatra has shown a consistent and significant decline in recent years. One of the main challenges faced by students is solving analytical problems, particularly those involving the application of force-related concepts, such as dynamics, work and energy, and momentum. Examination data indicate that many students struggle to apply Newton's Second and Third Laws when solving more complex problems.

A common difficulty involves analyzing the forces acting on objects moving on inclined planes, which further complicates their ability to evaluate the work done on such objects. These findings suggest that students' difficulties in understanding Newton's Laws may be a fundamental issue affecting their ability to master other related topics in physics. Consequently, this points to a potentially low level of conceptual understanding among students in physics.

TABLE I. The mean score of the physics national examination in Indonesia (West Sumatra).

Year	Mean Score
2015	79.96
2016	62.55
2017	56.13
2018	44.40
2019	47.32

Conceptual understanding plays a crucial role in the construction of new knowledge, including in physics learning [6]. However, many students struggle to grasp physics concepts [7–9], analyze them accurately, and are often prone to misconceptions [7]. The low conceptual understanding can lead to misconceptions, which may increase cognitive conflict [10–12] and result in frustration or overconfidence, both of which can reduce students' motivation to learn [13].

If misconceptions are not addressed through appropriate remediation, they may persist and obstruct students' ability to construct and deepen their understanding of physics concepts [12]. These misconceptions may also be passed down to future generations if students who hold them become educators. Therefore, early remediation of misconceptions is essential [12, 14]. Moreover, students' low conceptual understanding will hinder their ability to generate and solve problems, as part of the higher-order thinking skills needed in learning physics in the 21st century.

Conceptual understanding and motivation in learning physics have a significant relationship-psychological factors, including learning, motivation, and self-efficacy, influence conceptual knowledge. Students who possess high levels of self-efficacy and motivation tend to have a deeper understanding of physics concepts [15, 16]. This is because motivation encourages active engagement in learning, while self-efficacy fosters confidence in one's ability to overcome academic challenges.

Moreover, motivation is strongly linked to the development of conceptual understanding. Students with high motivation, especially those with a strong sense of self-efficacy, tend to have clear goals, maintain commitment, and plan their learning in a structured manner. Confidence in their abilities increases their motivation to learn and understand physics concepts [15, 17]. In this regard, motivation also plays an essential role in organizing students' actions to achieve their goal of success.

Motivation is a key element in supporting academic achievement and effective learning processes [18, 19]. It refers to both internal and external drives that initiate, direct, or sustain certain behaviors [20]. Motivation significantly influences students' interest in learning, which in turn affects their academic performance [21]. Motivation is the primary mechanism of behavior that is goal-oriented and instructs a person to take action to accomplish their objectives [22].

Motivation plays a crucial role in creating learning environments that encourage students' active participation in various learning activities [23]. Higher levels of learning motivation are positively correlated with improved student achievement [24]. Therefore, motivation has a considerable impact on the effectiveness of the learning process. Teachers can foster student motivation by understanding and responding to their learning needs, thus encouraging more active engagement [25]. In this context, the use of learning resources such as comics can be one solution to strengthen students' conceptual understanding and motivation in learning physics.

Yulianti *et al*. (2016) demonstrated the effectiveness of using comics as a learning tool for interpreting and implementing science [26]. This is because presenting science through illustrations in comic books is often more engaging and accessible than simply stating abstract facts. Similarly, Özdemir & Eryılmaz (2019) found that instructional comics contribute to creating a more enjoyable learning experience [27]. In addition, the direct and straightforward language used in comics has the potential to spark students' interest in science and motivate them to read further [28]. Another study also shows that comic-based learning increases students' interest and enjoyment in the subject matter, whereas traditional textbooks may have the opposite effect [29]. Beyond learning strategies and materials, students' learning styles also play a significant role in determining learning success. Therefore, when selecting learning resources and strategies, consideration should be given to students' learning styles.

The concept that individuals have different learning styles was first popularized in the 1970s [30]. Early studies revealed that learners tend to have specific preferences in processing and acquiring new information [31]. Many learning theories suggest that aligning instructional design with these learning styles can improve the educational process. Since then, teachers have frequently employed learning style inventories, especially in the implementation of the Merdeka curriculum in Indonesia, to gain insight into students' learning preferences and help them better understand how they learn.

Learning styles are typically measured using instruments grounded in established theories of learning preferences. One widely used tool is the Learning Style Inventory (LSI), a questionnaire designed to assess and identify individuals' strengths and learning preferences [32]. Understanding students' learning styles can support the development of effective study habits and foster greater engagement and motivation throughout the learning process.

This research aims to analyze the need for developing the Physicist-Muslim Comic based on students' and teachers' perceptions. This research was conducted with the following objectives:

1. To obtain information related to physics topics that are considered difficult based on student and teacher perceptions.

2. To identify the learning activities required by students and teachers in carrying out physics learning.

3. To identify the learning resources used by students and teachers in learning physics, as well as students' perceptions of the need for comics as a physics learning resource.

4. To identify students' learning style preferences.

This research represents the initial phase ("Analyze" stage) of the Physicist-Muslim comic development project, which is developed using the ADDIE model. This research provides the fundamental foundation for developing an appropriate Physicist-Muslim comic aimed at enhancing students' conceptual understanding of physics, particularly regarding Newton's Laws. This comic is also expected to serve as an innovative learning resource that accommodates diverse student learning styles and presents physics concepts in a contextual and enriched manner, incorporating religious values.

2. Methods

2.1. Research design

This study is descriptive research using a quantitative approach in the form of a survey design [33]. It aimed to provide a quantitative description of students' and teachers' attitudes and perceptions regarding challenges in physics learning. In this study, the researcher surveys a sample of the population to describe attitudes, opinions, behaviors, or characteristics of the population. Quantitative data were collected through questionnaires and analyzed statistically to describe trends in responses to the research questions. The general steps in conducting a survey study include determining research objectives, identifying the population and sample, designing and validating instruments, collecting and analyzing data, drawing conclusions, making recommendations, and reporting and disseminating findings [33, 34].

2.2. Population and sample

The population in this study was 17,673 public senior high school students in Padang, West Sumatra, during the 2023/2024 academic year, who were enrolled in physics courses https://dapo.kemdikbud.go.id/. The sample comprised 384 students and 20 physics teachers, selected using a simple random sampling technique. The student participants consisted of 186 female and 198 male students, with an age range of 15-18 years, representing 17 public senior high schools in Padang that have implemented the current Merdeka curriculum. The sample size for this study was determined using the formula provided by Krejcie & Morgan (1970) [35].

The participating schools were public senior high schools under the supervision of the West Sumatra Provincial Education Office, representing both central and peripheral areas of Padang City. These schools serve students from diverse

TABLE II. The component of the students' needs analysis questionnaire.

Num.	Aspects	Indicators	Item numbers	Response Type
1	Learning Style	a. Visual b. Audio c. Kinesthetics	a. A1-A5 b. A6-A10 c. A11-A15	4-point Likert scale
2	Physics Learning	a. Difficult topics in physics b. Learning activities c. Learning resource	a. B1-B3 b. B4-B5 c. B6-B12	checklists and short answers
3	Force and Newton's Laws	Students' attitudes and perceptions towards learning the topic of Forces and Newton's Laws	C1-C22	4-point Likert scale

TABLE III. The component of the students' needs analysis questionnaire for learning style.

Learning Style	Questionnaire Items
Visual (V)	I like to learn by reading information about the topic being studied
	I easily remember information presented in the form of pictures
	I easily remember the size, shape, and color of objects
	I learn best by watching someone do it first
	I am good at following written rather than verbal instructions
Auditory (A)	I like to learn by listening and discussing with friends
	I easily learn something when I listen to the teacher's explanation
	I like to discuss in small groups
	I understand one or more foreign languages
	I understand the learning topic well when I listen to the teacher's recorded explanation
Kinesthetic (K)	I like to do work directly
	I easily understand a concept if I am involved in hands-on activities to prove the concept
	I am skilled in using practicum tools or learning media
	I like to do learning activities that involve physical activity
	I like to learn physics through hands-on experiences

socio-economic backgrounds. Indonesian is used as the primary language of instruction. Additionally, the students' social environment reflects strong cultural and religious values, as evidenced by the implementation of daily spiritual activities and the availability of prayer facilities (musholla) on school premises.

2.3. Research instruments

The instruments used in this research were questionnaires for both teachers and students. These needs analysis questionnaires were developed by the researcher, based on relevant theoretical frameworks and findings from preliminary field observations. The student questionnaire focused on analyzing student learning styles, experiences in physics learning, and students' perceptions of Force and Newton's Laws. The indicators used in the student needs analysis questionnaire are presented in Table II.

The student needs analysis instrument employed a Likert-type response scale based on levels of agreement [36]. The Likert scale is widely recognized as an essential tool in educational research, particularly for measuring individuals' opinions, attitudes, and behaviors toward specific phenomena [37]. This questionnaire used a 4-point Likert scale (Strongly Agree, Agree, Disagree, Strongly Disagree). The 4-point scale was selected to minimize the tendency of respondents to choose a neutral midpoint, which may reduce the accuracy of the responses [38].

The measurement of students' learning styles in this study was adapted from the VARK learning style model [39] and the Learning Style Inventory (LSI) developed by Middlesex Community College (https://www.middlesex.mass.edu/ace/downloads/lsi.pdf). The instrument was modified to suit the context of physics learning, focusing on the three dominant learning styles: visual, auditory, and kinesthetic. This adaptation was made based on the consideration that VAK is widely recognized and commonly applied in the education community. The questionnaire items used to identify students' learning style tendencies are presented in Table III.

The teacher questionnaire was designed to gather insights into how physics instruction is currently implemented, the

TABLE IV. The component of the teachers' needs analysis questionnaire.

Aspects	Indicators	Item numbers	Response Type
Physics learning	a. Difficult topics in physics b. Learning activities c. Learning resource	B1 - B19	checklists and short answers

TABLE V. The component of the students' needs analysis questionnaire.

Num.	Aspects	Indicators	Item numbers	Response Type
1	Learning Style	a. Visual b. Audio c. Kinesthetics	a. A1-A5 b. A6-A10 c. A11-A15	4-point Likert scale
2	Physics Learning	a. Difficult topics in physics b. Learning activities c. Learning resource	a. B1-B3 b. B4-B5 c. B6-B12	checklists and short answers
3	Force and Newton's Laws	Students' attitudes and perceptions towards learning the topic of Forces and Newton's Laws	C1-C22	4-point Likert scale

types of learning resources used in the classroom, and the perceived need for the development of physics comics that integrate Quranic values. The indicators used in the teacher needs analysis questionnaire are presented in Table IV.

The teachers' and students' need analysis questionnaires were validated by six experts, comprising four physics lecturers, one guidance and counseling lecturer, and one physics teacher. Content validity was assessed based on the relevance and clarity of the items. The Content Validity Index for Items (I-CVI) was used to evaluate item validity. According to Lynn (1986), when six or more experts assess the instrument, each item must have an I-CVI value of at least 0.78 to be considered valid [40]. Based on the analysis of the I-CVI, the values for the items in the teachers' and students' questionnaires, which ranged from 0.80 to 1.00, indicate strong content validity.

Reliability of the instruments was measured using Cronbach's Alpha and the Kuder-Richardson Formula 20 (KR-20), with a reliability coefficient of 0.70 or higher considered acceptable [41]. The results of the validity and reliability analysis of the teachers' and students' needs analysis questionnaires are summarized in Table V.

2.4. Data collection

The data collection technique used in this study was the survey questionnaires. These questionnaires were designed to gather students' and teachers' perceptions regarding physics learning at the senior high school level. The instruments were administered via Google Forms to facilitate efficient and wide-reaching distribution. The data collection procedures implemented in this research are illustrated in Fig. 2.

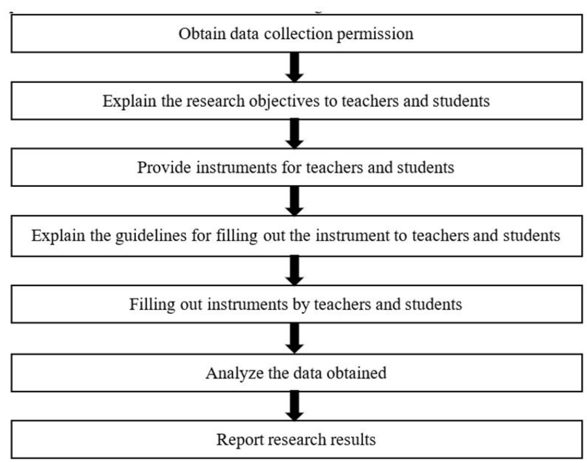

FIGURE 2. Data collection procedure.

2.5. Data analysis technique

The data in this study were analyzed using descriptive statistical methods, specifically through the use of percentages, to interpret responses from the questionnaires [33]. Descriptive statistical analysis is a method to summarize and present data in a manner that is clear and easy to interpret. This method helps to provide an overview of the characteristics and tendencies reflected in the collected data. Additionally, students' learning styles were categorized based on the total score of the most frequently selected items, indicating their dominant learning preferences.

3. Results and discussion

The needs analysis in this research was conducted based on the perceptions of both teachers and students. Challenging physics topics were identified from the perspectives of these

TABLE VI. The content validity and reliability of teachers' and students' need analysis questionnaires.

Num.	Instruments	Indicators	Mean I-CVI	Reliability
1	Student Questionnaire	a. Learning Style	0.99	0.753
		b. Physics Learning	0.99	0.738
		c. Force and Newton's Laws	1.00	0.814
2	Teacher Questionnaire	Physics Learning	1.00	0.713

two groups. This study also explored the types of learning activities and learning resources considered necessary to support physics learning. Furthermore, this research also identified students' learning styles in studying physics, providing a more comprehensive understanding of their learning needs.

3.1. Difficult topics in physics

Physics content at the senior high school is characterized by its emphasis on fostering a deep understanding of fundamental principles and their practical application. In Indonesia, the physics curriculum for senior high schools is aligned with the Merdeka curriculum, which allows schools and teachers the flexibility to adapt learning materials to suit students' needs and potential.

This study identified physics topics perceived as challenging to learn and teach, based on the perspectives of both students and teachers. The identification focused on 15 main physics topics covered in Grades X and XI. A summary of the topics considered most challenging is presented in Table VI.

Overall, students perceive all physics topics taught in Grades X and XI as challenging. 46.4% of students stated that dynamics was the most difficult physics topic. This topic covers fundamental concepts such as various types of forces, Newton's Laws and their applications in daily life, and a particular emphasis on gravitational forces. The subtopic identified as most difficult by students relates to force and Newton's Laws.

In contrast, 65% of teachers reported that rotational dynamics and equilibrium of a rigid body are the most challenging topics to teach. According to teachers, students' difficulties in understanding rotational dynamics stem primarily from challenges in force analysis. Moreover, students' limited mastery of Newton's Laws further hinders their ability to analyze torque and apply relevant concepts to rotational motion problems. The fundamental principles of Newton's laws strongly support the topic of rotational dynamics, although the focus shifts towards the forces and torques that produce changes in rotational motion. This is reflected in the fact that 50% of teachers also identified dynamics, including kinds of forces and Newton's laws, as difficult material to convey effectively to students.

Newton's Laws are often regarded as challenging concepts for students to grasp. Both teachers and students consistently identify Newton's Laws as the most difficult physics topic to understand. This perception is illustrated in Fig. 3,

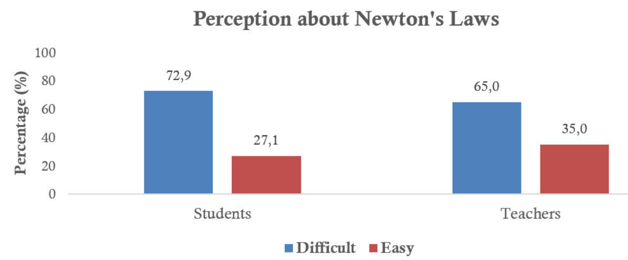

FIGURE 3. The Students' and Teachers' Perceptions of the Topic Newton's Laws.

which presents the views of both students and teachers regarding the complexity of learning Newton's laws.

Based on the data obtained, 65% of teachers and 72.9% of students stated that Newton's Laws are among the most challenging topics for students to understand and learn. According to students' perceptions, there are several specific challenges they encounter when studying Newton's Laws. First, students struggle to analyze the concept of force acting on objects. This difficulty is related to interpreting free-body diagrams, breaking forces into vector components, and determining the net force responsible for an object's motion. Second, students often struggle to comprehend the concepts and analyze phenomena related to Newton's First Law. Third, many students tend to memorize formulas without grasping the underlying principles of Newton's Second Law, which hinders their ability to solve related problems effectively. Finally, students also experience difficulties in solving problems and interpreting real-life phenomena that involve **Newton's Third Law**.

Furthermore, the data obtained from the student questionnaire on Newton's Law revealed that 62.8% of students experienced difficulties in understanding the concept of force and Newton's laws. In addition, 28.6% of students reported that although the learning resources they had used were varied, these materials had not effectively supported their understanding of Newton's Laws. Moreover, 93.8% of students stated that learning about Newton's Laws should be supported by experimental activities to enhance conceptual understanding. Similarly, 90.8% of students expressed the need for learning resources that incorporate visual representations to help clarify abstract concepts related to Newton's Laws. Furthermore, 90.6% students also believed that integrating Al-Quran verses, demonstrating the relevance of Newton's laws to real-life phenomena, could improve their conceptual understanding and motivate them to study and apply Newton's Laws in daily life.

The findings of this study are consistent with previous research that also highlights students' difficulties in learning Newton's Laws. Students frequently struggle to apply Newton's laws of motion to real-life situations, particularly Newton's third law [42]. These difficulties often lead to misconceptions and hinder their ability to analyze related phenomena. Additionally, students encounter problems in performing calculations and identifying the appropriate units when applying Newton's Laws, particularly Newton's Third Law [43].

Students' limited conceptual understanding of force and Newton's Laws can negatively impact their comprehension and learning outcomes in other physics topics, particularly those related to mechanics, such as circular motion, gravitational forces, and rotational dynamics [44]. To address this issue, it is crucial to select suitable learning activities and complementary instructional resources. The selection of such resources and activities should take into account students' learning needs, particularly in terms of their learning styles and the specific characteristics of the subject matter.

Overall, the abstract physics concepts often make it challenging for students to relate these ideas to real-world phenomena. Many students struggle to grasp physics concepts due to the large number of formulas they are expected to memorize [2]. Furthermore, students frequently demonstrate limited problem-solving ability in physics. This difficulty often stems from a tendency to rely on memorization rather than conceptual understanding, which hinders their ability to analyze and solve problems effectively. Such challenges pose a significant barrier to the effectiveness of physics learning.

Students' understanding of physics concepts can be reflected in their ability to provide relevant examples, explain concepts, draw conclusions, and classify information [45]. This previous study found that while students demonstrated strong ability in classifying problems based on appropriate concepts, their ability to explain those concepts was at a moderate level. However, their ability to generate relevant examples and draw conclusions remained at a low level.

Although teachers and students identify different physics topics as the most difficult, both groups attribute these difficulties to the same underlying issue: a lack of conceptual understanding of Newton's laws. Teachers further emphasized that students' limited grasp of force and Newton's laws negatively affects their knowledge of other physics topics, particularly rotational dynamics.

The findings of this study are consistent with previous research indicating that students face significant challenges in learning Newton's Laws [46]. Masalesi (2022) reported that students demonstrated a low level of conceptual understanding (mean score: 37.58) on the topic of Newton's Law, primarily due to conceptual difficulties and the presence of misconceptions.

The challenges students encounter in learning physics are attributed to internal, curricular, and subject-specific factors [47]. Abstract physics material, the absence of engaging instructional methods, limited conceptual understanding, prevalent misconceptions, and a mismatch between instructional approaches and students' learning preferences all contribute to these difficulties. Internal factors, such as students' belief that physics is inherently complex and their inadequate preparation for learning, further exacerbate these challenges [48]. These findings highlight the complex interplay between the inherent complexity of physics topics and the multifaceted obstacles students face in comprehending and applying physics concepts. This emphasizes the need for innovative learning strategies and interventions to enhance physics learning outcomes, such as the utilization of learning activities and resources.

3.2. Learning activities

Learning activities play an essential role in enhancing student engagement, conceptual understanding, and academic performance in physics. Empirical evidence suggests that learning activities significantly influence students' achievement in physics [49]. Students' involvement in the physics learning process is essential to support the optimal attainment of learning objectives. This perspective highlights the importance of implementing diverse instructional methods that align with students' learning needs in physics learning.

An analysis of learning activity needs in physics was conducted based on the perceptions of both students and teachers. The results of this analysis are presented in Fig. 4.

Overall, both teachers and students emphasize the importance of incorporating learning activities, such as experiments, simple projects, quizzes, virtual laboratories, and hands-on experiences, into physics learning. Among these, experiments are considered the most essential. A total of 78.4% of students and 90% of teachers agree that conducting experiments in physics learning is highly necessary. Experimental activities have been shown to enhance students' independent learning skills [50], significantly improve learning outcomes [51], and significantly increase both students' conceptual understanding and interest in physics [52].

In addition to experimental activities, both students and teachers consider hands-on experience and the creation of simple projects to be essential components of effective

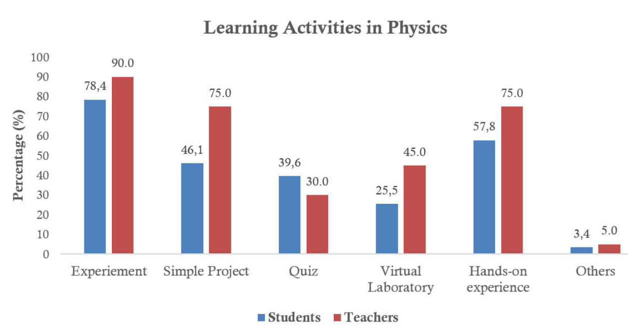

FIGURE 4. The learning activities needed in physics based on students' and teachers' perceptions.

physics instruction. Designing simple projects in physics learning has been shown to increase student engagement, improve learning outcomes, and foster a more enjoyable and meaningful learning environment [53]. Moreover, hands-on experience plays a crucial role in education, as it enables students to develop practical skills that cannot be fully understood through theory. Engaging students in hands-on activities has been proven to strengthen their scientific process skills in physics learning [54]. These activities may include direct practice, activity-based tasks, repetitive exercises, and assignments that relate to real-world contexts.

The use of virtual laboratories offers a practical alternative to conducting physical experiments, especially when access to conventional laboratory facilities is limited. Virtual laboratories enable students to explore and reinforce physics concepts through simulated experimentation, bridging the gap when hands-on experiments cannot be conducted directly. Previous research has shown that virtual laboratories have a positive impact on student motivation and engagement, which in turn can enhance learning outcomes [55]. Quizzes can also be effectively integrated into instruction as a formative tool to assess students' understanding of the material at each session. This aligns well with the formative assessment approach encouraged by the Merdeka curriculum.

In addition, a small proportion of students and teachers expressed the importance of verbal explanations by the teachers and the opportunity to work through numerous practice problems. Verbal explanations play a crucial role in clarifying complex physics concepts and fostering a deeper understanding. Research indicates that in addition to visual explanations, verbal explanations also make a significant contribution to students' learning outcomes [56]. Overall, the need for diverse and engaging learning activities in physics can be addressed by utilizing appropriate learning resources that align with students' learning preferences and styles.

3.3. Learning resource

Learning resources play a crucial role in improving the quality of physics learning. The use of engaging and interactive learning resources can significantly increase students' interest and motivation in learning physics [57]. Based on the questionnaire results obtained from both students and teachers, the types of learning resources currently used in physics instruction are illustrated in Fig. 5.

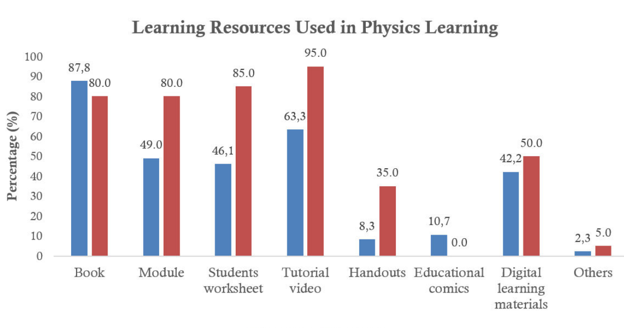

FIGURE 5. The physics learning resources based on students' and teachers' questionnaires.

Based on the collected data, 87.8% of students reported using books as their primary resource for learning physics. Additionally, 2.3% of students utilized other resources, including e-books, teacher-prepared PowerPoint slides, educational websites, and YouTube videos.

Using printed books in physics learning offers both benefits and limitations. Books play an essential role in supporting effective physics instruction, enhancing students' scientific literacy, and fostering positive spiritual attitudes [58]. Furthermore, previous studies have demonstrated that books are highly effective in improving students' problem-solving skills in physics [59].

However, selecting appropriate printed books requires careful evaluation to ensure that they meet educational standards and accommodate students' diverse learning styles. In contrast, digital books offer the advantage of flexible access anytime and anywhere [60], although extended screen time while reading digital materials can lead to eye strain and discomfort [59].

On the other hand, 10.7% of students reported that they had used educational comics, although none had ever encountered physics comics. The comics they referred to were primarily for general entertainment purposes. Based on their prior experiences with reading comics, 79.4% of students expressed the belief that comics could support their conceptual understanding in physics. They stated that the illustrations and storytelling elements in comics were easier to recall and remained in their memory longer. This led them to believe that physics comics could make abstract concepts more accessible and make learning physics more enjoyable.

Previous research has shown that comics offer an engaging and educational approach to learning physics, and they are effective in enhancing student learning outcomes, particularly on topics such as Newton's Laws [61]. Additionally, the development of Comic-Based Learning Modules (CLMs) has been shown to enhance students' conceptual understanding in physics [62]. These findings highlight the significant role of comics in supporting students' comprehension and academic performance in physics, whether through fully developed comic materials or the integration of comic-style illustrations into other instructional resources. This shows the

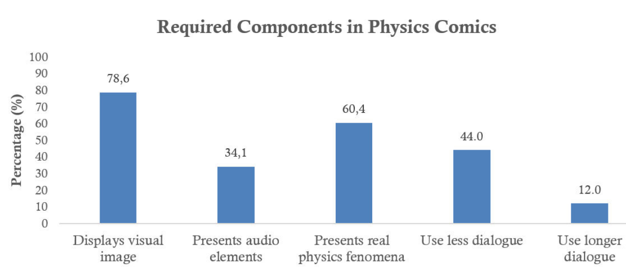

FIGURE 6. The components that students need in physics comics.

need to develop comics that emphasize the real-life relevance of physics concepts.

To support effective physics learning, several components are needed in the design of physics comics, as illustrated in Fig. 6.

The analysis of student responses to the needs analysis questionnaire indicates that students require strong visual elements to be featured prominently in comics used as learning tools in physics. In addition, the storyline should be grounded in the daily life experiences of the comic characters and supported by simple investigative activities or experiments to reinforce the concepts presented. Furthermore, students also expressed the need for audio-based explanations integrated into the comic. This feature would support auditory learners in enhancing their understanding of physics concepts through multimodal learning resources.

Meanwhile, 95% of teachers reported using video tutorials, mainly sourced from YouTube, as part of their physics instruction, while none reported using educational comics in teaching. Video tutorials are commonly used not only to deliver instructional content but also to enhance learning for students who lack access to laboratory facilities [63].

The tutorial-based approach used in videos has been found to improve students' conceptual understanding, particularly in topics such as mechanics [64] and Singh (2004) also noted that video tutorials can enhance students' problem-solving abilities. However, some students continue to experience difficulties in understanding and applying physics concepts effectively [65].

Moreover, research has shown that video tutorials may not guarantee long-term retention, as it remains unclear whether students can solve similar problems weeks after exposure to the tutorial. While videos can support conceptual understanding, they are generally ineffective in addressing students' misconceptions [66]. Additionally, videos have limitations in conveying complex physics concepts, which may contribute to the persistence of misconceptions [67]. Nonetheless, the positive impact of videos is particularly evident among students with a visual learning style [65].

In terms of learning resources, not all teachers have developed their learning resources to use in teaching or for students to utilize in learning physics. 35% of teachers reported relying on various websites and YouTube as their primary sources. They cited time constraints as a significant barrier to developing customized learning resources.

On the other hand, 65% of teachers have developed their physics learning materials, tailored to the specific conditions of their students and school contexts. These learning materials often incorporate specific learning models, which effectively support the instructional strategies implemented in the classroom. However, their use is limited to class groups that use the same learning model on the same topic.

Notably, most teachers rarely integrate Al-Quran verses or local wisdom into their learning resources. Incorporating religious values from the Al-Quran and cultural values rooted in local wisdom could enhance the implementation of the Pancasila Student Profile (Profil Pelajar Pancasila), a key feature of the Merdeka curriculum [3].

The integration of Al-Quran values can be implemented through physics comic panels that present verses relevant to specific physics concepts while also illustrating the embedded life values. For instance, in introducing Newton's First Law, a comic panel might depict a character riding in a car at a certain speed without wearing a seatbelt. When the car suddenly brakes, the character's body is projected forward. The comic's narration would introduce the concept: "In the absence of external forces, an object at rest remains at rest and an object in motion continues in motion with a constant velocity (that is, with a constant speed in a straight line)" [66]. The Al-Quran reinforces this concept which means: "Verily, Allah will not change the state of a people until they change their own state" (Q.S. Ar-Ra'd: 11). This verse highlights the physical and moral-spiritual idea that change occurs due to intrinsic and extrinsic effort, including individual motivation and initiative. It conveys the message that Allah does not change the condition of people unless they initiate change within themselves, whether in attitude, mindset, or behavior.

The narrative depicted in the comic panel also highlights the importance of using a seatbelt as a practical measure to counteract the effects of Newton's First Law in the illustrated scenario. It emphasizes individual responsibility for ensuring personal safety, in alignment with the Qur'anic principle that stresses self-initiated change. This integration reflects a key element of the Pancasila Student Profile (Profil Pelajar Pancasila), namely faith in God Almighty, devotion, and noble character.

The text and explanation of this Al-Quran verse can be placed across several panels before the end of the comic. This placement is designed to enable students first to understand Newton's First Law and its practical applications. After grasping the concept and engaging in the proof-of-concept activity, they will be better prepared to reflect on the values embedded in the Al-Quran verse. This sequence facilitates a deeper analysis of the verse, which illustrates real-life phenomena throughout the comic.

The integration of this example into the narrative and visual structure of the comic is expected to increase students' motivation and conceptual understanding, especially practical applications, life value, and spiritual insights related to Newton's First Law. This approach reinforces the role of educational comics not only as visual learning tools but also as holistic educational media that promote value-based learning and critical thinking.

Furthermore, the suitability of learning resources used by teachers to the needs of students' learning styles also shows a gap. Based on teachers' questionnaires, 95% of learning resources employed cater to visual learning styles, and 85% support auditory learners. However, only 55% of these resources are designed to accommodate kinesthetic learning styles. This is reflected in the widespread use of instructional videos in physics instruction, with 95% of teachers incorporating them into their teaching.

While videos are effective for visual and auditory learners, they may not sufficiently engage students who benefit more from hands-on activities. Given that each student has unique learning preferences, teachers need to select instructional materials that cater to this diversity. Therefore, the use of physics learning resources should be carefully aligned with students' diverse learning styles to optimize engagement and learning outcomes. Teachers are encouraged to adopt resources that not only enhance understanding but also make learning physics more enjoyable and meaningful.

The results of the analysis indicate that the learning resources used by both teachers and students are generally interactive and varied. However, their application tends to favor certain learning styles, particularly auditory and visual learning styles. Meanwhile, students have diverse learning styles. Therefore, when selecting and developing learning resources, it is necessary to consider students' learning style tendencies. This aims to ensure that student learning outcomes can be achieved effectively and equitably across diverse learners.

3.4. Identification of students' learning styles

The VAK (Visual, Auditory, and Kinesthetic) learning style is a fundamental consideration in the design of learning under the Merdeka curriculum. It is designed to help both teachers and students identify their learning preferences and develop more engaging and diverse learning strategies.

The classification of students' dominant learning styles in this study is based on their responses to items in the Student Needs Analysis Questionnaire related to learning preferences. Students were categorized according to their highest perceived learning style. The distribution of learning styles identified in this analysis is illustrated in Fig. 7.

The results of the student needs analysis related to learning styles indicate that 121 students have the Visual-Auditory-Kinesthetic (VAK) learning style as their most dominant learning preference. While some students demonstrated a single learning preference, such as audio, visual, or kinesthetic only, this does not imply the absence of other learning tendencies. Instead, it reflects the predominance of one learning style over others. This finding is supported by a detailed analysis of students' responses to the questionnaire items that address learning style preferences.

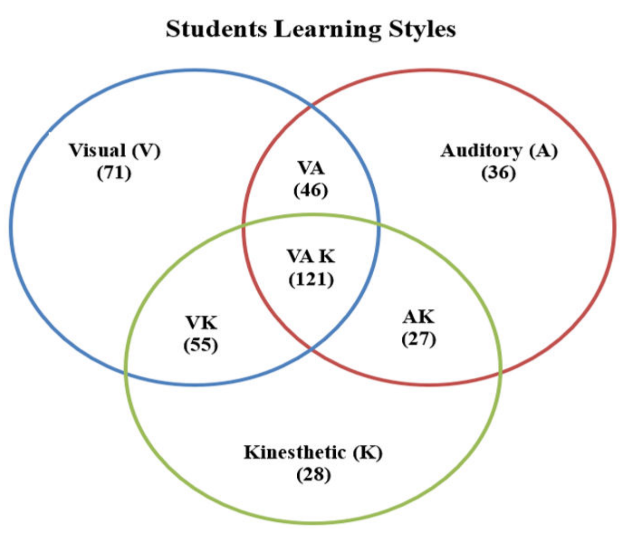

FIGURE 7. The grouping of student learning styles.

Overall, the majority of students exhibit a relatively balanced tendency across visual, audio, and kinesthetic learning styles. The data indicate a strong inclination toward visual learning. For instance, students tend to prefer reading information and observing others' actions as part of their learning process. They also report greater ease in recalling information presented visually, such as images, and remembering the size, shape, and color of objects. Notably, 78.4% of students indicated that they follow written instructions more effectively than oral ones.

Furthermore, the data also shows that students prefer and find it easier to learn through listening to teacher explanations or engaging in peer discussions. Additionally, many students express a preference for active participation in the learning process, such as conducting hands-on activities or utilizing interactive learning materials. They believe that being directly involved in physics-related activities during learning helps them gain a better conceptual understanding.

The results of this student learning style analysis serve as a crucial consideration in instructional planning. Research conducted by Halim *et al.* (2021) showed a positive and significant correlation between learning styles and physics learning outcomes [68]. Furthermore, adopting appropriate learning styles is essential for effectively processing information, as evidenced by findings in entrepreneurship education and career development contexts [69]. Given the diversity of students' learning preferences, instructional strategies and resources should be carefully designed to accommodate visual, auditory, and kinesthetic learning styles. Doing so can help students leverage their dominant learning preferences to achieve educational goals more effectively.

The results of the in-depth analysis conducted in this study highlight the need to develop physics comics that reinforce both pedagogical aspects and religious values in students. These comics can serve as a flexible learning resource, applicable both in the classroom and for independent learning, especially in learning Newton's Laws. The comic design should focus on enhancing students' conceptual understanding of Newton's Laws and addressing common misconceptions. The content should include analysis of forces, Newton's First Law, Newton's Second Law, Newton's Third Law, as well as their real-life applications. Moreover, the comics should explicitly integrate religious values by demonstrating the relevance of Newton's Laws to verses from the Al-Quran. Equally important, the comics should incorporate features, such as visual storytelling, simple experimental activities, and interactive quizzes to accommodate students' diverse learning styles, including visual, auditory, and kinesthetic. Thus, the comics can function as a comprehensive learning resource that supports the goals of the national curriculum.

4. Conclusion

These research findings reveal that 65% of teachers and 72.9% of students identified Newton's Laws as a challenging topic to learn and understand. An analysis of the available physics learning resources indicates that the materials currently in use do not adequately accommodate students' diverse learning styles. While 95% of these resources support visual learning and 85% support auditory learning, only 55% cater to kinesthetic learners. However, this study also found that 121 students reported a dominant Visual-Auditory-Kinesthetic (VAK) learning preference. This highlights the importance of integrating all three learning styles into learning resources. Furthermore, 79.4% of students expressed a need for visual learning resources, such as physics comics, which they believe would enhance their conceptual understanding in physics. In addition, 90.6% of students indicated that incorporating verses of the Al-Quran to demonstrate the relevance of Newton's Laws would support both conceptual understanding and spiritual reflection.

Based on the data analysis conducted in this research, it can be concluded that there is a clear need to develop physics comics for Newton's Law. These comics should be carefully tailored to accommodate students' diverse learning styles, including visual, auditory, and kinesthetic, to ensure more effective engagement and conceptual understanding. Furthermore, integrating the Al-Quran verses into the comics is essential to highlight the relevance of the material to life values, thereby enhancing students' motivation to learn physics and supporting deeper conceptual comprehension.

However, this study has several limitations. First, the data collected were limited to student-related issues in Padang, which may affect the generalizability of the findings. Second, the analysis relied primarily on student and teacher perceptions, without triangulation from additional sources such as classroom observations. The absence of direct classroom observation limits the depth of insight into the contextual realities of physics instruction. Third, the study did not include detailed sociodemographic data, such as students' socioeconomic background or parental education, which could provide a more nuanced understanding of learning challenges.

To overcome this limitation, future research should consider incorporating classroom observations of both student and teacher activities to gain a deeper understanding of the underlying causes of challenges in physics learning. Additionally, expanding the scope of data collection to include schools from various cities and districts across West Sumatra, or even a wider regional area, would enhance the generalizability of the findings and provide a more representative picture of the difficulties faced by students in learning physics.

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