

Received : 17 June 2022
Revised : 19 November 2022
Accepted : 21 November 2022
Online : 8 December 2022
Published: 30 December 2022

DOI: doi.org/10.21009/1.08206

Profile of Students' Conceptual Understanding of Physics in Senior High School

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Abstract

This research aimed to identify the profile of physical concept mastery of Senior High School/Aliyah School students in Semarang as a result of the transition from offline to online learning. The research employed the descriptive quantitative approach in which the tests and questionnaires were used to collect data. The school type (Senior High School/Aliyah School), school ownership (Private/State), and student's interest in learning are all considered in the profile analysis. This study was carried out in Semarang, Indonesia, with a sample of 250 students from three high school, MAN 2 Semarang, SMA Negeri 1 Semarang, and SMA Negeri 9 Semarang. The findings revealed: 1) The percentage of students with concept mastery scores with the highest answer being questioned was 12 (88.2%). The results showed: 1) The percentage of students with concept mastery scores that really the highest answer lies in question 12 with a percentage of 88.2% on fluid material (Bernoulli's Law) with a cognitive level of C2. While the percentage value of the student's mastery of concepts which is the lowest, lies in questions number 3 (Uniform Speed and Uniform Acceleration subject matter) and 4 (moment of inertia/center of gravity and rigid body balance subject matter) with a percentage of 57% each with successive levels of cognition, C3 and C4, 2) Following tutoring is not effective because it does not affect physical learning achievement, and 3) there is a positive (unidirectional) significant (mean) relationship between independence and learning motivation on physical learning achievement. The results of this study can be used as a reference for researchers, educational policymakers, and stakeholders related to the handling of post-pandemic education.

Keywords: profile analysis, mastery of physics concepts, the effectiveness of tutoring, independent learning

INTRODUCTION

Due to the Covid-19 disease outbreak, students' classrooms have shifted from entirely offline to online and restricted face-to-face. Adjustments in learning mode could have an impact on how students learn. This circumstance can undoubtedly affect students' knowledge and understanding of subject matter, such as physics subjects in high school/madrasah aliyah.

Furthermore, the teacher plays a significant role in learning. These two requirements are challenging to achieve once learning occurs online. This is consistent with the findings of Winarti's research, which found that during a pandemic, the materials that require experimentation have the highest percentage of students learning the basic concepts of Science and Physics (Winarti 2021). Furthermore, the study found that the two main factors influencing student learning difficulties in one the tertiary institutions are internal factors, such as a lack of motivation to learn, and external factors, such as a less supportive home environment, family economic factors, lecturer presentation, limited facilities and infrastructure,

and the characteristics of the lecture material (Winarti 2021). The findings of this study will be utilized to develop this research instrument.

The previous study investigated high school students' self-efficacy toward mastery of concepts in learning during the disease outbreak. The findings of this study indicate that students' self-efficacy is high because they are already familiar with online learning (Eva et al. 2021). The study's findings were influenced by students' and educators' digital literacy. Students and educators with good digital literacy can help achieve learning goals; however, students and educators with low digital literacy will hinder the achievement of learning goals.

Further research into mitigating and overcoming the impact of Covid-19 on learning is required. Many factors influenced the achievement of learning objectives in online learning, including online facilities and infrastructure for schools and students, material content, learning methods, the learning management system (LMS) used, students' and teachers' digital literacy, and so on. Profile research is one of the most important sources of data in such mitigation and countermeasures. The problem is desired to be mapped based on the characteristics of the school, the type of school, and the school's location through research on the mitigation profile and overcoming the impact of Covid-19 on the mastery of physics material in high school.

Semarang is among the cities with a high Covid-19 transmission rate, and the online learning process has been running for nearly two years. As a result, learning outcomes in this city, particularly physics, are either significantly influenced. Meanwhile, student profile information is essential as a reference for learning improvement.

The following are several previous studies related to the research on the profile of mastery of physics concepts. The previous research examined the profile of students' physics concept mastery using DiBek and P2D learning (Rasagama 2021). Concept mastery is assessed using a validated test instrument of up to 40 multiple-choice questions. Another study used a four-tier diagnostic test to investigate students' mastery of concepts in the free fall motion sub-material (Rahayu and Hariyono 2019). The research subjects were 50 students from class X. This research investigated the possibility of students experiencing misconceptions about free fall motion. According to the findings, 40.67% had misconceptions, 26.67% understood partially, 16.67% did not understand the concept, and 15.33% comprehended the concept altogether. According to Zulfikar et al. 2017, the four-tier diagnostic test consists of a statement of questions, beliefs about the answers to these questions, reasons for the choice of answers, and beliefs about those reasons.

Previous studies studied the profile of high school students' concept mastery of temperature and heat. Reasoned multiple-choice questions are used as the test instrument (Yuliana et al. 2019). According to the study's findings, most students did not understand the concepts of temperature and heat. A similar study used a question instrument that could identify answers and their reasons (Sundari 2019). Another research used multiple choice questions to examine the profile of mastery of temperature and heat material concepts (Azizah et al. 2019). The concept of Shiva is divided into three levels of mastery: low, medium, and high. Meanwhile, previous studies used representation and scientific consistency to determine the concept mastery profile (Rahayu 2021), whereas other studies examined the consistency of representation and coherence of students' understanding (Yuningsih 2019).

The previous study investigated the concept mastery ability profile of SMK Cendekia Madiun class X students in physics lessons (Purwito et al. 2020). The test instrument used consisted of 20 multiple-choice questions ranging in cognitive level from C1 to C6. Students' conceptual mastery is divided into five categories: very poor (0 - 20), less (20 - 40), sufficient (40 - 60), good (60 - 80), and very good (80 - 100). The findings revealed that most students are in the sufficient category.

Various attempts have been made to improve students' conceptual knowledge and understanding. The following is a review of the literature on guided inquiry models assisted by interactive multimedia (Yulianci et al. 2017, Hidayat et al. 2019), inquiry learning assisted by virtual laboratories (Kusdiastuti et al. 2017), guided inquiry (Yeritia et al. 2017) and (Suwandari et al. 2018)), video-assisted inquiry (Yolanda et al. 2019), virtual media to support project-based learning (Suranti et al. 2017), experimental kits to support guided inquiry (Pramudyawan & Doyan 2020), and (Turrahmah et al. 2019) used experiment tools to support discovery learning.

Based on the description above, it is clear that the instrument for mastering concepts primarily employs test instruments, with the test format being multiple choice. Multiple-choice questions with reasons for the answers can be used to identify misconceptions. This literature will be used as a resource in the development of this research tool. Based on this context, a study titled “Profile conceptual understanding of physics in Senior High School/Madrasah Aliyah in Semarang City” was conducted.

METHODS

A total of 250 students from SMA Negeri 1 Semarang, SMA Negeri 9 Semarang, and MAN 2 Semarang took part in the conceptual understanding test, questionnaire, and interview. This is descriptive quantitative research data. Quantitative data in the form of test scores and questionnaires for students’ mastery of physics concepts. This study was carried out in several Semarang schools, including SMAN 1 Semarang, SMAN 9 Semarang, and MAN 2 Semarang. SMA Negeri 1 Semarang represented SMA Negeri in the city center of Semarang, SMA Negeri 9 Semarang represented SMA Negeri on the outskirts of Semarang, and MAN 2 Semarang represented Madrasah Aliyah in Semarang.

A conceptual understanding test and a questionnaire were used in this study as instruments. The conceptual understanding test consists of 16 multiple-choice questions. Remembering, understanding, applying, and analyzing are all cognitive aspects. Before being used, questions are developed and validated by experts. Questions are typed into Google forms and completed online at a predetermined time. All physics concepts are covered, including quantities and units, motion, energy, momentum, electricity and magnetism, rotational dynamics of rigid bodies, fluids, waves, optics, and thermodynamics.

The questionnaire consists of closed questions with a Likert scale of 1 to 5. The questionnaire is used to collect information about student interest in physics subjects and the learning process. A total of 250 students from SMA Negeri 1 Semarang, SMA Negeri 9 Semarang, and MAN 2 Semarang took part in the concept mastery test, questionnaire, and interview.

RESULTS AND DISCUSSION

The findings of this study address three issues—first, a description of each subject’s mastery of physics concepts. Second, there is a link between students’ interest in learning physics and their understanding of physics concepts. Third, there is a link between tutoring and mastery of physics concepts.

FIGURE 1 depicts the percentage score for mastery of physics concepts at the Senior High School/Madrasah Aliyah Semarang City for each item, including quantities and units, motion, energy, momentum, electricity and magnetism, rotational dynamics of rigid bodies, fluids, waves, optics, and thermodynamics.

FIGURE 1 shows that the percentage of students with concept mastery scores who answered correctly was 88.2% on fluid material (Bernoulli’s Law) with a cognition level of C2. While the percentage value of the concept mastery score of students who answered correctly was 57% in questions 3 (Uniform straight motion and uniform, straight motion change concept) and 4 (moment of inertia / center of gravity and rigid body balance concept) with successive levels of cognition C3 and C4, With cognition levels of C2, C3, and C4, a total of 13 questions out of 16 on the percentage of students’ concept mastery scores who answered correctly were above 75 percent. However, in as many as three of the sixteen questions, the percentage of students with concept mastery scores who answered correctly fell below 65%. The three questions are number 2 and 3 on the Uniform straight motion and uniform straight motion change concepts, as well as number 4 on the moment of inertia material/center of gravity and rigid body balance concepts, with a percentage of students’ concept mastery scores who answered correctly of 64%, 57%, and 57%, respectively. Compared to other topics, uniform straight motion and uniform, straight motion change concepts, as well as the center of gravity and rigid body balance, particularly the moment of inertia, can be the most challenging material. In general, students have a 77.23% mastery of physics concepts with a good enough category. The findings of this study outperform those of Effendi et al. (2018). According to the findings of this study, the overall ability of students’ concept mastery is 60.38%, placing them in the medium category.

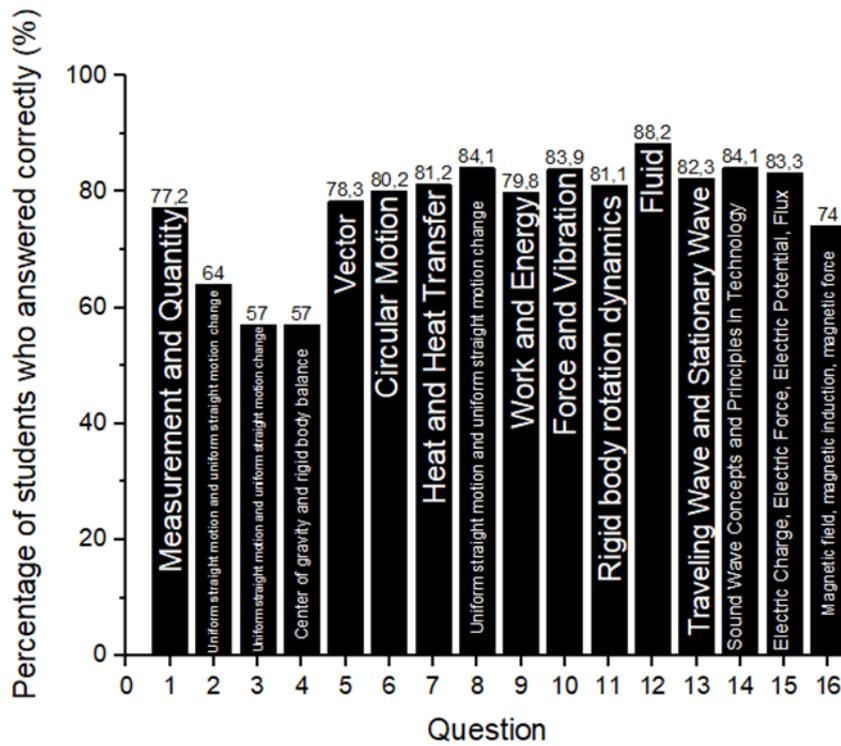


FIGURE 1. Percentage of students with correct answers on each item

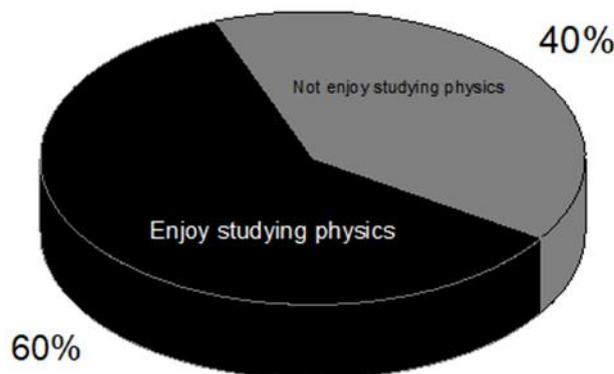


FIGURE 2. Percentage of Students who Enjoy Learning Physics and Not Enjoy Learning Physics

FIGURE 2 depicts a pie chart of the percentage of students who enjoy learning physics by 60% and 40% who do not enjoy learning physics. According to this study, a large percentage of students who enjoy learning physics have an impact on their mastery of physics concepts. Several studies back up this assertion. Students' interest and motivation affect learning physics achievement in class XI IPA SMA Negeri 1 Galing, Sambas Regency (Sari et al. 2016). Furthermore, a significant influence between MTs Nurul Rahmat Bontolanra students' learning interest and MTs Nurul Rahmat Bontolanra students' physics learning achievement (Nurhidayat 2015). A positive influence on learning motivation on student physics learning achievement in class X SMA Negeri in Mendoyo District (Setiawan et al. 2016). Then, for the 2016/2017 academic year a significant relationship between interest in learning and physics learning achievement for class XI students at SMA Negeri Karang Jaya (Charli et al. 2019).

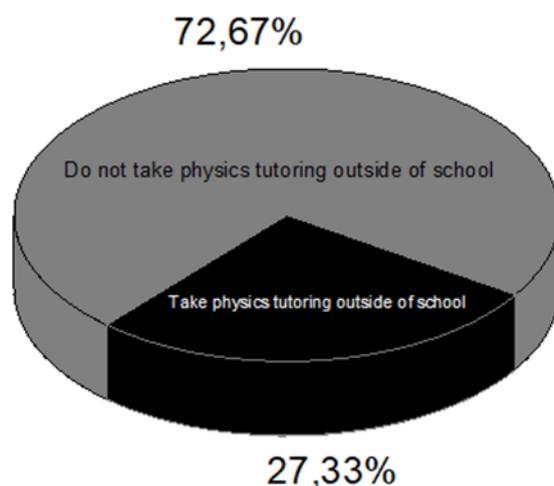


FIGURE 3. Percentage of Students Taking Physics Tutoring and Not Taking Physics Tutoring

FIGURE 3 depicts a pie chart of the percentage of students who receive physics tutoring outside of school (72.67%) and those who do not (27.33%). According to the study's data, the average score of students who take the course and those who do not take the course is 75. Following the findings of this study, tutoring is ineffective since it does not affect physics learning achievement. The additional learning significantly influences physics learning outcomes for students at SMP Negeri I Sungguminasa Kab (Situju 2013). Gowa in South Sulawesi Province. The results of this study contradict the results of another research (Situju 2013 & Prananda 2019) because most (about 60%) of the 250 students consisting of class XII students from SMA Negeri 1 Semarang, SMA Negeri 9 Semarang and MAN 1 Semarang enjoy learning physics independently. The findings of this study contradict previous study (Situju 2013 & Prananda 2019) because the majority (about 60%) of the 250 students from SMA Negeri 1 Semarang, SMA Negeri 9 Semarang, and MAN 1 Semarang enjoy learning physics independently. The findings of the related study (Saefullah et al. 2013) revealed a significant (mean) positive (unidirectional) relationship between the attitude of learning independence and learning achievement. This means that the higher the student's attitude toward learning independence, the higher the student's learning achievement. There is a positive and significant relationship between learning independence and student learning outcomes in physics learning at SMAN 1 Syamtalira Bayu (Sanita et al. 2021).

CONCLUSION

The study concludes that students' mastery of physics concepts in Senior High School/Madrasah Aliyah Semarang City is quite three good due to the learning conditions shifting from offline to online. The average percentage of students who correctly answered all 16 questions was 77.23%. The 16 questions range in cognition level from C1 to C4. Meanwhile, students at Senior High School/Madrasah Aliyah Semarang City have a high level of learning independence and enjoyment of physics. Independence and enjoyment in learning physics positively and significantly affect student achievement in learning physics at Semarang City Senior High School/Madrasah Aliyah.

ACKNOWLEDGMENT

This research was supported by the APBU (University Research and Expenditure Budget) research grant 2021, provided by the Institute for Research and Community Service (LPPM) Universitas PGRI Semarang.

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