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SIMPLE HARMONIC MOTION CONCEPTUAL MASTERY THROUGH *GUIDED INQUIRY LEARNING* ASSISTED BY ONLINE MULTIMEDIA

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ABSTRACT

Abstract: This study aims to analyze the students' mastery concepts of Simple Harmonic Motion on Guided Inquiry learning assisted by online multimedia. The study involved 36 students of class X natural science of SMA Negeri 4 Jember. A multiple choice test was used to measure mastery concept and was conducted before and after learning. The data obtained were then analyzed using a mixed method with an embedded experiment design. The results showed that the increase in students' concept mastery was influenced by the guided inquiry learning model assisted by online multimedia. Based on the effect size value, the learning carried out has an effect on the strong effect category. The average increase in students' mastery of concepts is in the high category.

INTRODUCTION

A natural phenomena can be comprehended effectively if the underlying facts, concepts, and principles are known (Mourhir et al. , 2016). The construction of pupils' concept mastery requires a methodical technique consisting of a sequence of acceptable scientific procedures and attitudes (Hursen & Asiksoy , 2015). The concept of basic harmonic motion is present in a variety of daily activities; consequently, it is crucial for students to have a thorough understanding of the concept. According to studies, students still have considerable misconceptions regarding simple harmonic motion (Malik et al. , 2019; Nugraha et al. , 2019). In basic harmonic motion, many students have difficulties differentiating deviation, period, and frequency. In addition, many students struggle to determine the value of the spring constant, the relationship between the force and the increase in spring length in a series spring circuit (Adolphus et al. , 2013). Students' challenges and lack of expertise in grasping simple harmonic motion is a problem that might result in a lack of conceptual understanding. To make it easier for pupils to grasp the notion of basic harmonic motion, effective instruction is required.

The guided inquiry learning approach can be applied to the construction of students' conceptual understanding since a number of scientific techniques are utilized to aid students in acquiring their own knowledge (Abdi, 2014; Thaiposri & Wannapiroon , 2015). In addition to appropriate learning models, media are also required to facilitate students' mastery of elementary harmonic motion materials. Students' knowledge can be supplemented via animations, films, simulations, and reading materials (Sriarunrasmee et al. , 2015). So as not to impede the learning process, it is necessary to provide easy access to media in the form of online multimedia (Taub et al. , 2015).

Guided inquiry learning aided by online multimedia can compel students to use all of their abilities and critical thinking skills to find information (Bruckermann et al. , 2017; Slisko & Cruz , 2013). The used online multimedia is an e-learning platform that can accommodate several media in one location and is accessible to students online. Schoology is a platform with complete e-learning capabilities. In Schoology, all audiovisual and textual materials are supplemented by exercises for the concept mastering of pupils. Students can not only learn about elementary harmonic motion, but they can also enhance their understanding. Implementing Schoology as online multimedia in guided inquiry learning is anticipated to improve students' conceptual understanding of simple harmonic motion.

METHOD

This study adopted a mixed technique with an embedded experiment design (research employing two methodologies, quantitative and qualitative, that are conducted nearly simultaneously) (Creswell, 2017). In this study, 36 students from class X IPA 6 SMA Negeri 4 Jember were enlisted as samples. The research was conducted from April 2019 to May 2019 during the even semester of the school year 2018-2019. Learning tools included Lesson Plans (RPP), Student Worksheets (LKS), and observation sheets. Beginning with observing events, asking questions, gathering data through practice, discussing, and communicating in front of the class, the lesson plans were created utilizing methodical approaches. A ten-question multiple-choice exam based on the topic of indications of simple harmonic motion will be used to evaluate students' conceptual understanding. On the basis of each student's responses and explanations, it is possible to determine the extent to which they have mastered the subject at hand. The scoring parameters were separated into three categories: two points for students who answered and offered the proper reason, one point for students who answered correctly but supplied the erroneous reason, and zero points for students who did not provide an incorrect response or answer and reason.

The pre- and post-test scores of the students were then examined quantitatively to determine the influence of online multimedia-assisted guided inquiry learning on the students' concept mastery. As a prerequisite for future testing, the first step is to ensure normality and homogeneity. When data are regularly distributed, the parametric difference test, paired sample t-test, can be applied. If the data are not normally distributed, however, the Wilcoxon non-parametric difference test is conducted. The difference between the pre- and post-test scores can be determined by comparing the significant values of the tests. Using Cohen's d value, the level of influence of learning on pupils' concept mastery was determined (Tomczak, 2014). The n-gain test was used to compare the pre- and post-test scores of pupils to see whether there was an increase in concept mastery (Waldrip , Rodie, Sutopo , 2014). Table 1 shows the interpretation of Cohen's value.

Table 1. Cohen's Values

Cohen's d Value	Interpretation
0-0.20	Weak effects
0.21-0.50	Modest effect
0.51-1.00	Moderate effect
>1.00	Strong effect

The accomplishment of each basic harmonic motion indicator was then determined by analyzing each item indicator. The increase in concept mastery scores of each indicator between the pre- and post-tests was analyzed, allowing the results to be compared with the reasons students gave for their answers and scores of student activity while learning, as well as interviews with a number of students as data. All of the results of the quantitative analysis were repurposed as qualitative analysis results to complement and explain the quantitative analysis results.

RESULTS

The results of the pre- and post-tests administered to 36 class X IPA SMA Negeri 4 Jember students demonstrated an increase. 32 students had an increase in their results in the high category, while four students saw an increase in their scores in the medium group. In general, all students' scores increased from the pretest to the posttest. The results of the Kolmogorov Smirnov normalcy test were 0.085 and 0.087, respectively. The data from the pretest and posttest had a normal distribution, hence a new paired sample t-test could be conducted.

The significance of the difference test was 0.000, indicating that there is a distinction between the value before and after learning. After the difference test was conducted and it was determined that there were changes in the scores of mastery of the idea of simple harmonic motion before and after learning, the effect size value was calculated using Cohen's effect. The calculated effect size was 1.62, placing it in the category of having a strong influence. The increase in concept mastery between the pretest and posttest is indicated by the n-gain value of 0.80, which was classified as high. Table 2 displays the overall rise in scores for each question indication.

Table 2. Percentage of student answers each category of concept mastery

No Items	Concept	Pretest (%)			Posttest (%)			*n-gain*
		2	1	0	2	1	0	
1	Characteristics of simple harmonic motion and examples in everyday life	0	67	33	89	11	0	0.92
2		0	17	83	78	22	0	0.88
3	Quantity relationship in the equation of motion of the pendulum harmonics	0	42	58	89	11	0	0.93
4		0	17	83	67	33	0	0.82
5		0	39	61	92	0	8	0.90
6		0	0	100	78	0	22	0.78
7		0	0	100	47	0	53	0.47
8	Quantity relationship in the equation of spring harmonic motion	0	0	100	72	0	28	0.72
9		0	47	53	75	19	6	0.80
10		0	0	100	83	0	17	0.83

The achievement of each category demonstrates mastery of concepts: a score of 2 for the correct answer and reason, a score of 1 for the correct answer and erroneous reason, and a score of 0 for the incorrect answer and reason. At the time of the pretest, there were no students who could accurately answer questions and provide explanations. The majority of students had a score of 0 while few received a score of 1. However, this was inversely proportionate to the posttest, which revealed that the majority of students could accurately answer the questions and provide the correct explanations. The number of students with a score of 2 is greater than the number of students with scores of 1 and 0, indicating that students' conceptual understanding has improved.

Sebuah pendulum dengan ujung berbentuk bola padat bergerak bolak balik melalui titik setimbangnya. Jika ujungnya diganti dengan bola yang lebih berat 2 kalinya, frekuensi gerak pada bandul menjadi...
a. Lebih besar
b. Lebih besar lalu mengecil
c. Tetap
d. Lebih kecil
e. Lebih kecil lalu membesar

		Posttest		Total
		A	C*	
Pretest	A	0	20	20
	C*	0	13	13
	D	0	3	3
Total		0	36	36

*Jawaban benar

Figure 1. Questions and results of cross tabulation of student answers

A more comprehensive analysis was undertaken to establish the students' pre- and post-test perceptions. The problem depicted in Figure 1 concerns the basic harmonic motion of a pendulum. In this question, pupils had the greatest rise, 0.93, and are therefore classified as high. The pendulum's frequency is determined by the force of gravity and the length of the pendulum string; the mass of the pendulum's weight has no effect on its frequency. If the pendulum remains in the same location and the string length does not vary, the pendulum's frequency remains constant. Twenty students responded A on the pretest, thirteen students answered C, and three students answered D. Some students who answered erroneously, specifically choices A and D, assumed that if the weight of the ball is more, then the frequency of the pendulum is likewise greater, or vice versa, based on their responses and explanations. The students' explanations failed to demonstrate that they had grasped the correct notion. Students have a tendency to provide vague justifications and to rely on conjecture in lieu of scientific evidence. Similarly, 13 students who replied correctly did not include explanations in the answer column, leading to the conclusion that they just chose the correct answer by chance. All students shifted to selecting option C on the post-test, indicating a shift in their thinking. However, not all students provided thorough and clear explanations. Students who have grasped the notion of harmonic motion in a spring will explain why the gravitational force and the length of the pendulum impact the frequency of the pendulum, but not the mass of the object. The frequency of the pendulum remains same despite the doubled mass of the object. Some students just reasoned that the object's mass has no effect on its frequency, without providing any further explanation.

DISCUSSION

Guided inquiry learning aided by online multimedia was found to have a modest impact on students' concept mastery scores. The level of learning influence utilized is 1.62, which falls into the category of strong effect. This is consistent with prior research indicating that guided inquiry learning can enhance students' concept understanding (Lestari et al. , 2018; Maulida et al. , 2020). Guided inquiry learning employs a sequence of logical steps so that students can maximize their problem-solving cognitive abilities (Maknun, 2020; Prahani et al. , 2016; Shin & McGee , 2014). The usage of online multimedia as a learning medium can improve student learning since students have the option to study the material and practice the provided questions outside of class time (Stelzer et al. , 2012; Su & Yeh , 2015). Schoology, a web-based multimedia platform, provides comprehensive tools for student learning (Sanchez Garcia et al. , 2018). In schoology, physics material is presented in a variety of formats, including simulations, animations, and reading texts, making it easier for students to comprehend (Sari et al. , 2020; Schlager , 2016). On the basis of the benefits of guided inquiry learning and online multimedia in the form of schoology, a study was done to assess students' knowledge of elementary harmonic motion concepts.

The findings of the examination of each item revealed an increase in scores for concept mastery and variations in student responses. Many students received a score of 0 on each item of the pretest because they did not respond or provide reasons. Some pupils' correct answers were not followed by the correct explanations. This demonstrates that the student's right answer on the pretest is not necessarily indicative of a strong grasp of the subject, as the student did not provide an explanation. However, during the pretest, students' thinking changed as they provided justifications for each answer. After studying and using schoology as a learning aid, the students' explanations became more logical. In each answer, students provide a thorough explanation; yet, some students who do not fully comprehend the content provide answers and explanations for what they are. Students' learning influences their shifting answers and evolving perspectives. Students who are active while learning and actively utilize Schoology receive higher grades than those who are motivated to participate in learning.

CONCLUSION

Guided inquiry learning aided by online multimedia has a strong influence on improving students' topic mastery as measured by test results. The majority of the rise experienced by students falls into the category of "high," while a few fall into "moderate." In each question indication, no score declined, however the n-gain value for several questions was in the moderate range. Students that actively participate in learning and make use of schoology have superior concept understanding.

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