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Research Artikel

WHICH ONE IS BETTER HANDS ON OR PHET SIMULATION ON HARMONIC OSCILLATION

MANA YANG LEBIH BAIK EKSPERIMEN ATAU SIMULASI PHET PADA GERAK HARMONIK

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Abstrak

Penelitian ini bertujuan untuk mengetahui mana yang lebik baik antara keterlaksanaan pembelajaran pendekatan saintifik kelas yang menggunakan hand on berupa media KIT dengan simulasi PhET dan peningkatan hasil belajar kognitif siswa diantara kedua kelas tersebut pada getaran harmonis. Metode yang digunakan dalam penelitian ini adalah quasi-experiment dengan desain randomized pretest-posttest comparison group. Populasi penelitian adalah kelas X MIA di MAN Cimahi. Sampel penelitian adalah siswa kelas X MIA 1 yang menggunakan hand on berupa media KIT dan kelas X MIA 3 yang menggunakan simulasi PhET. Sampel dipilih dengan teknik random sampling dengan jumlah siswa masing-masing 35 orang. Hasil penelitian menunjukkan keterlaksanaan pembelajaran pendekatan saintifik dan peningkatan hasil belajar kognitif siswa di kelas yang menggunakan hand on berupa media KIT lebih baik dibandingkan simulasi PhET. Hal ini dapat disimpulkan pembelajaran pendekatan saintifik yang menggunakan hand on berupa media KIT lebih baik dibandingkan simulasi PhET.dalam pelaksanaan maupun dalam meningkatkan hasil kognitif siswa pada getaran harmonis. Dengan demikian, penggunaan media KIT dan simulasi PhET dapat diimplementasikan untuk meningkatkan hasil belajar kognitif siswa pada topik fisika lainnya.

Kata Kunci: *Hasil Belajar Kognitif; Media KIT; Simulasi PhET; Getaran Harmonis*

Abstract

This study aims to determine which is better between the implementation of classroom scientific approach that uses hand-on in the form of KIT media with PhET simulations and improvement of students' cognitive learning outcomes between the two classes on harmonic oscillation. The method used in this study is quasi-experiment with a randomized pretest-posttest comparison group design. The study population is class X MIA at MAN Cimahi. The sample of the research is class X MIA 1 students who use hand on KIT media and class X MIA 3 using PhET simulation. Samples were selected by random sampling technique with 35 students each. The results showed the implementation of the scientific approach to learning and the improvement of cognitive learning outcomes of students in the classroom using hand-on in the form of KIT media is better than the PhET simulation. It can be concluded that learning a scientific approach that uses hand-on in the form of KIT media is better than a PhET simulation. Both in implementation and in improving students' cognitive outcomes in harmonic oscillation. Thus, the use of KIT media and PhET simulations can be implemented to improve student cognitive learning outcomes on other physics topics.

Keywords: Cognitive Learning Achievement; KIT Media; PhET Simulation; Harmonic Oscillation
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INTRODUCTION

The learning is done to building knowledge and developing human potential. The knowledge obtained from the achievement of a study that was done when the learning process is done. The achievement of learning is a change in behaviour that can be observed, shown through actual ability possessed of a person (Asyhari & Silvia, 2016; Lavery & Coffey, 2016). As for the achievement of the study generally can be categorized into three aspects of learning, i.e., aspects of cognitive, affective and psychomotor (Chang, Lai, & Hwang, 2017; Sutrisno & Siswanto, 2016). The principles and skills of developing knowledge are the results of cognitive learning. The cognitive aspect is more emphasis on the development of the realm of knowledge by the student than another aspect (affective and psychomotor). The cognitive aspect is the main thing that has been reached so that the other aspects will be more easily reached by the student. The cognitive outcome is the results of the study about mental processes that began from the knowledge and will have an impact on others ability. The cognitive aspect is related to the results of the learning of the student after attending the course and this aspect gives the detail of the success of the learning (Jua *et al*, 2018; Lestari, 2015; Lestari, 2016; Prastowo, 2017).

The cognitive aspect is the aspect that many trained and emphasized on the learning process in school. One of the factors that can increase the cognitive outcomes of students with learning media use is proper. The benefits of the learning media in the learning process of students are: (1) learning is more attractive to get the attention of students so as to foster motivation learning; (2) learning content will display with more clearly, its meaning the abstract concept can be concrete and it makes the student has been a better understanding of the content and let them achieve the learning objectives; (3) the method of teaching will be more varied, so students don't get bored; (4) the students have more chance to have contributed in learning activities because is not just listen to teacher's description but also other activities such as observe, perform, demonstrate, plays, and other (Copriady, 2015; Henderson *et al*, 2017; Johnson-Glenberg *et al*, 2016).

Cognitive learning achievement much emphasized to be developed on each student in school, because to achieve aspects of affective (attitude) and psychomotor (action) is required the achievement of a good understanding of learning content in the realm of knowledge, so that they can prepare students to become qualified human beings in the future (Fhadhila *et al*, 2018; Batong & Wilujeng, 2018; Sutrisno & Siswanto, 2016; Weatherspoon *et al*, 2015). Generally, to find out the extent to which the results of a study of the cognitive outcome of the student, can be viewed from the result of learning in school. But, in fact, that not all students can solve any question correctly; this is certainly indicated that their knowledge is still not achieving the desired target in the learning process, or it can be said the cognitive outcome still low. The low of the cognitive achievement of students may be caused by the learning media that used is not diverse and not adapted to the topic presented. Then, the learning process in the classroom impressed monotonous and boring (Kaniawati *et al*, 2016; Zakrajsek, 2018).

One way to overcome these problems can be laboratory activities. This reason is based on the process contained in laboratory activities consist of the activity of demonstrations, computer simulations, and experiments activities. Laboratory activities can provide more experience to students, increase conceptual understanding, and developing practical skills. Furthermore, the experiment method helping the students to use their imagination, develop of critical thinking skills, create a hypothesis, reveal ideas, enhance of the interest of the students, develop of creative thinking skills and problem-solving abilities, as well as facilitate the development of the process of scientific thinking, and science process skills (Malik *et al*, 2017). Therefore, to support laboratory activities can be done using a variety of instructional learning media. The learning media widely used in school was a KIT media. But, the use of this KIT media still has limitations, because not all schools have owned KIT media. The

researches and educational practitioner make a virtual learning media that oriented to computer-based learning to minimize cost and more efficient in uses, including in the form of applications Physics Education Technology or better known by the abbreviation PhET. Besides, the next problems are not all the teachers are can use this virtual media and not all schools provide computers and internet access are adequate to access the PhET website (Ajredini *et al*, 2017; Jauhari *et al*, 2017; Randall & Emily, 2016; Setiadi & Muflika, 2015).

KIT media is one of the three-dimensional media designed for a specific objective to lead to a continuous or sustained process (Wibawa & Mukti, 1993). According to Mujadi & Wiratno (1994) stated that the KIT is a set of science equipment that usually is used directly to help explain a scientific concept. KIT media of science is practice tools normally used in experiment activities (Lepiyanto & Pratiwi, 2015; Oktafiani *et al*, 2017; Panero & Aldon, 2016; J.-Y. Wang *et al*, 2015; Weatherspoon *et al*, 2015).

Virtual laboratories have several advantages, consisting of being able to explain abstract concepts that cannot be explained through verbal teaching, can be a place of experimentation that cannot be done in a real laboratory, mobility and wider reach are not limited to place and time, the process and implementation can be carried out independently and requires faster time (Malik, 2010). PhET simulation is one of application of virtual laboratory that created to visualize experimental activities in the computer-based laboratory. All of the equipment laboratory needed by students are simulated in the software. PhET simulation was developed by a team from the University of Colorado United States. PhET was developed to help students understand concepts visually. PhET simulations animate something that invisible of the eye such as the use of graphics or intuitive controls while click and drag manipulation, sliders and audio buttons. PhET is easy to use and is applied in the classroom, before using the PhET simulation, the computer requires installed java program and flash. Also, PhET can also be used online on the website https://phet.colorado.edu (Ajredini *et al*, 2017; Jauhari *et al*, 2017; Saregar, 2016; Setiadi & Muflika, 2015).

Based on research conducted previously show the use of KIT media can increase the scientific skills and scientific attitude (Setiawan *et al*, 2018; Weatherspoon *et al*, 2015). The same study concluded that KIT media invites the student to learn the science as a whole, not just memorize concepts, but also learn the what, why, and how to do these concepts found through experiments in the laboratory (Purnamawati *et al*, 2017; Wibowo *et al*, 2016; Wickham *et al*, 2016). The using media of KIT expected students would motivate and achievement of learning will be increased. The results of the same study were also concluded by Oktafiani *et.al* (2017) that the processability and understanding of students can be enhanced through the utilization of KIT media. On the other side, using PhET simulation can be a solution to enhance the cognitive learning results of the students. PhET simulations can be visualization, especially the difficult concept that cannot visualization verbal (Oktafiani *et al*, 2017). The similar studies are also carried out by Johnson-Glenberg *et.al*, (2016); Purnamawati *et.al*, (2017); and Saregar *et. al*, (2016) that the results of a study using PhET Simulation more effective, practical and fun. As well as the results of research the learning that utilizes of PhET simulation have the learning outcomes better than learners without using PhET simulation (Ajredini *et al*, 2017; Jauhari *et al*, 2017).

The novelty of this study, comparing the use of KIT media and PhET simulations in improving cognitive learning achievement in a topic related to mechanics, especially harmonic oscillations. Previous research focuses on the comparison of the use of KIT media and PhET simulation on an abstract topic such as electricity. Besides, in this study, the application of the scientific learning approach using both media was analysed qualitatively and quantitatively through observation sheets observed by observers. The relationship between student scores in answering questions related to cognitive aspects in the student worksheet given at each meeting with the post-test score was analysed. It aims to obtain more comprehensive

data related to the influence of the use of KIT media and PhET simulations during the scientific approach learning in harmonic oscillation topics.

METHOD

The research method used in this research is an experiment method with a quasi-experimental type of randomized pre-test post-test comparison group design. This research was conducted on two groups of students as a class of experiment (experiment 1 and experiment 2). The researcher conducted a pre-test to find out the cognitive learning achievement of students before being given treatment. The treatment given was in the form of a scientific approach learning to use KIT media in experimental class 1 and PhET simulation in experimental class 2. The learning process in this study used a scientific approach that consists of observing, asking, experimenting, associating, and communicating. The stages of learning used media of KIT as well as PhET simulation almost the same, it just has the difference on stage experimenting. The implementation of the learning process in the two experimental classes was measured using an observation sheet. The physics content learned by students consists of harmonic oscillation with simple harmonic oscillation sub-content in spring, at the pendulum, and energy on harmonic oscillations. Post-test was conducted to determine the effect of using KIT media and PhET simulation on the learning process on students' cognitive achievement. Data obtained from the results of this study were then analysed quantitatively and qualitatively. Examples of student laboratory activities related to simple harmonic motion in class using KIT media and PhET simulation are shown in Figure 1.

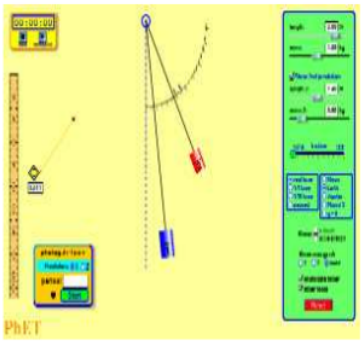

Figure 1. Laboratory activities in classes using KIT media and PhET simulation

The aspects of students' cognitive learning achievement measured in this study using the revised Bloom taxonomy framework. Aspects of cognitive learning consist of remembering (C1), understanding (C2), application (C3), analysing (C4), evaluating (C5), and creating (C6) (Adams, 2015). During the learning of approach scientific using KIT media and PhET simulation, cognitive learning achievement of students trained using worksheets. The data obtained were analysed and interpreted to description student' cognitive learning achievement.

This research population was class X MIA MAN Cimahi consisting of three classes with the amount of 120 students. The sampling technique was used which is a simple random sampling. The sample of the study was class X MIA 1 as experimental class 1, which uses KIT media with 35 students consisting of 13 males and 22 females. Grade X MIA 3 as the class of experimental 2 using PhET simulation with 35 students consisting of 14 males and 21 females.

The data obtained through observation sheet instruments, student worksheets, pre-test and post-test instruments for cognitive learning achievement. The observation sheet is used to get the data of implementation of learning approach scientific obtained through observations during instructional activities. The observation sheet using the rubric that specific and measurable verified by the expert. The worksheet is a supporting instrument used to train students cognitive learning achievement and to analyse implementation each stage of learning

approach scientific in the classroom. The worksheet contains questions that can train the aspect of cognitive learning achievement. Cognitive learning achievement tests used amounted to fifteen in form essay tests. The test used to know the achieve of indicators of cognitive learning outcomes as well as the significance of increased cognitive learning achievement of students.

Data onto the observation sheet was analysed by calculating the percentage implementation of the learning of approach scientific uses KIT media and PhET simulation. The results of the calculating data were interpreted using the criteria of learning in Table 1.

Table 1. Criteria implementation of learning approach scientific

Interval	Criteria
≤ 54%	Too low
55% - 59%	Low
60% - 75%	Middle
76% - 85%	Good
86% - 100%	Very Good

The learning implementation of using KIT media and PhET simulation is also analysed qualitatively based on comments from observers on the observation sheet.

The results of student worksheets were analysed by calculating the percentage of students' answers to interpreting the cognitive learning achievement from each stage in learning of scientific approach to each meeting. Criteria for cognitive learning achievement of the student based on Chatfield (2018) can be seen in the following Table 2.

Table 2. Criteria for student cognitive learning achievement

Score	Interpretation
30 – 40	Fail
40 – 55	Low
56 – 65	Middle
66 – 79	Good
80 – 100	Very Good

The increase in cognitive learning achievement of students is analysed with normalized gain (<g>) value against the pre-test, and post-test. The value of (<g>) obtained interpreted according to the criteria of Hake (1998) in Table 3.

Table 3. Criteria of normalized gain (<g>)

Interval <*g*>	Criteria
(<*g*>) < 0,3	Low
0.7 > (<*g*>) > 0.3	Medium
(<*g*>) > 0.7	High

RESULT AND DISCUSSION

Learning of approach scientific uses KIT media

The implementation of learning media of KIT was given to enhance the cognitive learning achievement of students on the harmonic oscillation content for the class of experiments 1. The treatment is given as much as three times. The results analyse the observation sheet implementation learning of approach scientific on each stage using KIT media showed in Table 4.

Table 4. Analysis implementation learning media of KIT based on the observation sheet

The learning stages of approach scientific	Implementation learning approach scientific use KIT media			
	Teacher (%)	**Interpretation**	**Student (%)**	**Interpretation**
Observing	83	Good	77	Good
Asking	80	Good	76	Good
Experimenting	82	Good	78	Good
Associating	81	Good	75	Middle
Communicating	86	Very Good	74	Middle
Average	82	Good	76	Good

The implementation of each stage of learning of scientific approach using KIT media is categorized well as both for teacher and student activities. The highest stage of learning the scientific approach is found at the experimental stage including the good category and the lowest at the communication stage including the middle category in student activities. The highest learning stage of the scientific approach is found at the

communication stage including very good and the lowest is the asking category including good in the teacher's activities.

Cognitive learning achievement students use KIT media

Result of cognitive learning achievement of students from learning of scientific approach using KIT media based on the worksheet showed in Table 5.

Table 5. Analysis students' cognitive learning achievement using KIT media based on worksheet

No	Aspect	Average	Interpretation
1	Memorizing	98.39	Very Good
2	Understanding	97.0	Very Good
3	Application	97.7	Very Good
4	Analysing	97.3	Very Good
5	Evaluating	89.3	Very Good
6	Creating	80.0	Very Good
Average		93.3	Very Good

Student cognitive learning achievement based on worksheets shows an average including very good categories. The aspect of creating included the lowest cognitive learning achievement compared to other aspects including very good categories. The highest aspect of cognitive learning outcomes occurs in the memorizing aspects including the very good category.

Student worksheets used to train students' cognitive learning achievement. Aspects of cognitive learning based on pre-test, post-tests, normalized gain (<g>) and worksheet are interrelated with each other. The distribution of pre-test, post-test score, and normalized gain (<g>) value on every aspect of cognitive learning achievement can be seen in Table 6.

Table 6. The improvement of every aspect of cognitive learning achievement

No.	The aspect	Pre test	Post test	<g>	Interpretation
1	Memorizing	19.52	85.16	0.82	High
2	Understanding	10.24	83.57	0.82	High
3	Application	2.86	83.10	0.83	High
4	Analysing	2.24	81.43	0.81	High
5	Evaluating	1.67	74.24	0.74	High
6	Creating	1.03	67.23	0.67	Medium

The increase in all aspects of students' cognitive learning outcomes including is the high category except aspect of creating including is the category of the medium. The application aspect reaches the highest value compared to other cognitive learning aspects. The lowest aspect of cognitive learning outcomes is found in aspects of creation.

Based on the results pre-test and a post-test score of cognitive learning achievement indicate the increases. The increase in cognitive learning achievement of students in the class using the KIT media show in Table 7.

Table 7. The increase in students' cognitive achievement learning using the KIT media

	Score		<g>	Criteria
	Pre-test	**Post-test**		
Sum	208.3	2781.7	0.78	High
Average	6.26	78.96		

The increase in cognitive learning achievement of students once used the learning media of KIT with normalized gain (<g>) 0.78 is high-level increase interpretation. It can be seen from the average score pre-test and post-test students have increased.

The pre-test and post-test score distribution after being calculated and analysed of normalized gain (<g>) students at each sub-content of harmonic oscillation can be seen in Table 8.

Table 8. The increase in students' cognitive learning achievement of sub-content

No.	Sub-content	Pre test	Post test	<g>	Interpretation
1	Harmonic oscillations on a spring	8.32	83.96	0.83	High
2	Harmonic oscillations on the pendulum	6.22	81.75	0.82	High
3	Energy on oscillation harmony	4.23	71.56	0.70	Medium

The average pre-test, post-test and normalized gain on harmonic oscillations on a spring sub-content reached the highest value compared to other sub-content. The lowest sub-content occurs in energy on oscillation harmony.

Learning of approach scientific use PhET simulation

The implementation of the learning of PhET simulation was given to enhance the cognitive learning achievement of students on the harmonic oscillation content for the class of experiment 2. The treatment is given as much as three times. The results analyse the observation sheet about the learning implementation of each stage in approach scientific using PhET simulation can be seen in Table 9.

Table 9. The Analysis implementation learning PhET simulation based on the observation sheet

The learning stages of approach scientific	Implementation learning approach scientific use PhET simulation			
	Teacher (%)	Interpretation	Student (%)	Interpretation
Observing	80	Good	73	Middle
Asking	81	Good	71	Middle
Experimenting	83	Good	74	Middle
Associating	82	Good	73	Middle
Communicating	81	Good	70	Middle
Average	81	Good	72	Middle

The implementation of each stage of learning the scientific approach to teacher activities is included in the good category while the activity of students is in the middle category. The lowest stage of learning of scientific approach in teacher activities occurs at the observation stage while in the student activities occur at the communicating stage. The implementation of learning the scientific approach of the experimenting stage is the highest compared to the other stages of teacher activities and student activities.

Cognitive learning achievement students use PhET simulation

The increasing of cognitive learning achievement of students from each stage in a scientific approach using PhET simulation based on the worksheet can be seen in Table 10.

Table 10. Students' cognitive learning achievement using PhET simulation based on worksheet

No	Aspect	Average	Interpretation
1	Memorizing	89.5	Very good
2	Understanding	72.3	Good
3	Application	68.7	Good
4	Analysing	62.4	Middle
5	Evaluating	60.8	Middle
6	Creating	56.6	Middle
Average		68.4	Good

Aspects of student cognitive learning achievement using PhET simulation based on worksheet analysis on average are included in good categories. The memorizing aspect reaches the highest average compared to other cognitive learning aspects. The creating aspect reaches the lowest average with the middle category.

The results of the data analysis of the relationship between pre-test, post-tests, normalized gain (<g>) and worksheet every aspect of cognitive learning achievement using PhET simulation are showed in Table 11.

Table 11. The improvement of every aspect of cognitive learning achievement

No	Aspect	Pre test	Post test	<g>	Interp-retation
1	Memorizing	19.04	77.92	0.73	High
2	Understanding	7.38	70.16	0.68	Medium
3	Application	4.24	66.33	0.65	Medium

No	Aspect	Pre test	Post test	<g>	Interp-retation
4	Analysing	3.56	64.71	0.63	Medium
5	Evaluating	1.67	61.93	0.61	Medium
6	Creating	1.29	53.57	0.53	Medium

All aspects of students' cognitive learning achievement after applied learning of scientific approach using PhET simulations have increased. Aspects of cognitive learning achievement of students have increased in the medium category except for the memorizing aspect including the high category. The aspect of creating is the lowest increase compared to other aspects. The highest increase occurred in the memorizing aspect.

Table 12 shows the increase in the cognitive learning achievement of students in the class using the PhET simulation.

Table 12. The increase in students' cognitive learning in the class using the PhET simulation

	Score		<g>	Interpretation
	Pre-test	***Post-test***		
Sum	210.0	2306.7	0.64	Medium
Average	6.0	65.9		

There is an increase in students' cognitive learning achievement after applied the learning of scientific approach using PhET simulation. The increased student's cognitive learning achievement is 0.64 including the medium category.

The distribution of scores of pre-test, post-test, and normalized gain (<g>) students at each sub-content harmonic oscillations in the class using the PhET simulation showed in Table 13.

Table 13. The increase in students' cognitive learning achievement of sub-content

No	Sub-Content	*Pre test*	*Post test*	<g>	Interpretation
1	Harmonic oscillations on a spring	9.92	73.43	0.71	High
2	Harmonic oscillations on the pendulum	2.24	60.12	0.59	Medium
3	Energy on oscillation harmony	6.45	63.78	0.61	Medium

The cognitive learning achievement of students in each sub-content after applied scientific approach learning has increased. The increased sub-content harmonic oscillation on spring is the highest compared to another sub-content. Sub content harmonic oscillation on the pendulum is the lowest including the medium category.

Test hypothesis

Hypothesis testing is used to find out the significance of increased cognitive learning results of students. The results of the cognitive of students compared after learning of scientific approach using KIT media and PhET simulation. The procedure hypothesis testing is done normality test, homogeneity test, and test hypotheses. Pre-test data normality test results by using the Shapiro-Wilk on the experimental class use media of KIT obtained significant value is 0.088 then it can be said that such data are distributed normally as greater than the probability value of 0.05. Whereas on the post-test results retrieved value of 0.029 then it can be said that such data is not normally distributed because it is smaller than the value of the probability of 0.05.

The results of pre-test and post-test data normality by using the Shapiro-Wilk on the class of experiments using PhET simulation obtained significant value pre-test and post-test are 0.077 and 0.160. It can conclude that the data is distributed normally as greater than the value of the probability of 0.05. Next, on its homogeneity test, pre-test and post-test data from both class experiments yield values of 0.175 and 0.066. It can be concluded that data is its homogeneity since the value of significance is greater than the value of the probability of 0.05.

The hypothesis test results using a t-test before using KIT media and PhET simulation show of the value significance 0.449 is greater than the value of 0.05 probabilities. It can be inferred that Ho and Ha were rejected, meaning there is no difference a significant student's cognitive learning achievement uses media KIT with PhET simulation on harmonic oscillation. Hypothesis test results to determine differences in students' cognitive learning achievement after applying KIT media and

PhET simulations using the Mann-Whitney U test are shown in Table 14.

Table 14. Hypothesis test results using Mann-Whitney

	Result
N KIT Media	35
N PHeT Simulation	35
N Total	70
Mean rank KIT Media	51.26
Mean rank PHeT Simulation	19.20
Sum of ranks KIT Media	1743.00
Sum of ranks PHeT Simulation	672.00
Mann-Whitney	42.000
Wilcoxon W	672.000
Z	-6.648
Asymp. Sig (2-tailed)	0.000

The result Asymp. Sig (2-tailed) shows a value significance of 0.000, the value is less than the value of 0.05 probabilities. It can be inferred that the Ha is received and Ho is rejected which means there is a significant difference in the outcome of cognitive learning of students use KIT media with PhET simulation on harmonic oscillation.

Discussion

Based on the results of the analysis of the implementation learning of the scientific approach in the classroom using KIT media, it can be seen that student activity with the lowest average is the stage of communicating. The stage communicating is the lowest because at this stage the student's required to be able to present the results of the group discussions after doing activities laboratory. Students must be bold and learn to speak in public to convey an opinion, but in fact, students still doubt and shame by reason of fear of wrong. Besides, students are too focused on the assembly and way use tools so that the remaining little time for presenting. The stage of experimentation is the highest because at this stage student are motivated to solve problems by doing practical work. Students are trained to make hypotheses, analyse experimental results and make conclusions.

The teacher's highest activity in the learning of the scientific approach using KIT media occurs at the communication stage. Teachers always provide motivation to students to be confident in conveying the results of discussions with group friends. Teacher activities at in the learning of the scientific approach using KIT media the lowest occur at the asking stage. The teacher functions as a facilitator to guide students in learning, so they don't ask many students questions. The excess learning media KIT that is able to increase the understanding of students through practical work in direct to prove a theory, avoiding verbalize on students and activity laboratory have done concretely. This is in accordance with the research conducted by Daryanto (2013) that excess owned media KIT as a three-dimensional media providing experience directly, show the object as a whole either construction or how it works, showing the organizational structure clearly, and shows the way or process clearly. As for the weakness of implementation, the KIT media among others requires a longer preparation, their use cannot be indiscriminate sake takes more time in assembling, using and sprucing up tools. Besides, the KIT media have limited to use by students in large numbers. Therefore, the use of the media of KIT is demanding students to be able to cooperate well in groups so that each stage of learning can be done well.

The implementation of student activities on learning of the scientific approach in the class using PhET simulation with the lowest average occurs at the communication stage. This is happening because students rely on only a few people when discussing and presenting results. The lowest stage of learning of the scientific approach in teacher activities occurs at the observation stage. The teacher has prepared various learning resources that will be used in each lesson. The implementation of scientific approach learning using the highest PhET simulation occurs at the experimental stage both in the activities of teachers and students. Students at the experimental stage have understood how to use various features in the PhET simulation. Students were very enthusiastic about conducting

experiments because students had never before conducted experiments with simulations.

The advantages of PhET simulation could involve the interaction among students and teachers, build the knowledge students independently, discovery and combining of prior knowledge of students and improves interest in studying students. These results indicate conformity with previous studies showed PhET simulation can improve involvement and interaction among students, educate students to have the thinking patterns of constructivism, make learning more interesting because the students can learn while playing, and visualize the concepts of science in the form of models (Jauhari *et al*, 2017; Johnson-Glenberg & Megowan-Romanowicz, 2017; Setiadi & Muflika, 2015).

As for the weakness of the PhET simulation based on research that has been done. At the beginning of the study, students were less motivated to carry out laboratory activities virtually. This is due to the limited number of computers that can display PhET so students have to take turns with their friends to do experiments. Besides, some students do not understand the features available in the PhET simulation. The weakness of the learning of scientific approach use PhET simulation rely on the independence of the students to follow the learning process, access to carry out virtual laboratory depends on the number of computer facilities provided schools, students can feel saturated if less understanding about the use of the computer so that it can give rise to a passive response to exercise virtual experiment. (Randall & Emily, 2016; Wibowo *et al*, 2016). Students need to adapt to the use of media virtual learning that hasn't been used before. Using the media virtual like PhET simulation is not yet commonly used in schools. Besides the preparation of means of computer and access internet is indispensable in the use of PhET simulation so that students can use it's to the maximum and eliminate boredom on the learning process (Liu, *et al*, 2017; Stowell, 2015; Torrente *et al*, 2014).

The results of the analysis of student worksheets in the experimental class using KIT media showed that the lowest cognitive aspects occurred in the aspect of creation. This is because students have not been able to design a tool about the application of harmonic oscillation topics in the context of everyday life. The highest aspect of remembering is compared to other cognitive aspects. Students can remember various steps that can be used to overcome the problems presented in the activity's laboratory. Problems that must be overcome by students are contextual related to the implementation of harmonic oscillation. (Suhendi *et al*, 2018). Furthermore, the results of the analysis of worksheets of students in the experimental class using the PhET simulation show that the increasing lowest cognitive aspects exist in creating. This is the same as what happened in the experimental class using KIT media. Students have not been able to apply the concepts learned to create a design tool that can be used to overcome a problem. The highest increase in cognitive aspects occurs in the remembering aspect, this is because students simply press the button contained in the PhET simulation by using the cursor to complete the task in the student work (Stowell, 2015).

Cognitive learning results in the experimental class using KIT media and PhET simulations have a significant increase between the results of the pre-test and post-test of students. This can occur because the results of cognitive learning students are trained using student worksheets. However, there is a decrease between the average score of student worksheets with the average score of post-test students both in the experimental class using KIT media and PhET simulation. This can be caused when the learning process of students is divided into several groups so that the scores of student worksheets produced are the result of discussion groups.

The score of pre-test and post-test of students are individual so that the resulting score is the result of the thought of each student. Besides, when learning activities, only a few students participate actively in expressing his ideas in solving the activity sheet so that not all students can be measured its ability to use sheets the work of students. However, the overall average score of worksheet students categorized either. This proves

that the use of the student worksheet as an instrument to train students' cognitive learning achievement is positive, meaning that the worksheets students can train and improve cognitive learning results in students significantly. This is in accordance with the results of Freeman *et.al* (2014) which shows the worksheets students can train and improve students' cognitive learning outcomes.

Based on the research that has been conducted on the experimental class use media KIT, the increase cognitive learning achievement of students seen from the results of a pre-test, post-test, and normalized gain <g>. The value of <g> obtained by comparing scores pre-test and post-test students i.e., 0.78, meaning an increase in cognitive learning achievement of students in harmonic oscillation included in the high category. The average of scoring the student worksheet with the category very good showing that the using media of KIT with the help of worksheets students can train aspect of cognitive learning results of students. Based on the research that has been done on the experimental class using PhET simulation shows students' cognitive learning achievement also experienced the same increase as in the class using KIT media. The value of a normalized gain <g> obtained by comparing students' pre-test and post-test scores, namely, 0.64 means that the increase in cognitive learning achievement of students in the topic oscillation harmonic is included in the medium category. The average score of the student worksheet includes the category enough. It shows that learning use PhET simulation with the aid of worksheets students can train aspect of cognitive learning results of students (Kexel *et al*, 2018).

Based on an analysis of the data obtained in the experiment class using media of KIT, the value of <g> average sub-content of harmonic oscillation the highest is a simple harmonic oscillation in spring with the value <g> an average of 0.83 and included in the high category. The highest increase in the experimental class using PhET simulation also occurs in sub-content of harmonic oscillations in spring. The increase in cognitive learning achievement in the experimental class using KIT media is greater than using the PhET simulation. This can be caused by simple harmonic oscillations in springs which are the first sub-content studied and considered easier compared to other sub-content. This sub-content is widely applied in tools found in students' daily lives. In addition, it is a prerequisite for studying the next harmonic oscillation sub-content.

The increasing of lowest harmonic oscillation sub-content in the experimental class using KIT media occurs in the energy of oscillating harmonic with a value of <g> 0.70 and included in the medium category. This can be caused because harmonic oscillation energy is the hardest sub-content for students to understand. Students are required to be able to implement two mathematical equations to solve problems related to oscillating harmonic energy. While the lowest increase in the experimental class using the PhET simulation occurred in the sub-content of harmonic oscillations on the pendulum with a value of <g> 0.59 and included in the medium category. This can be caused because students are still confused about the use of mathematical equations when solving problems related to the sub-content of harmonic oscillations on the pendulum.

The value of <g> the highest on aspects of cognitive learning results in the experimental class uses a KIT media is aspects of the application to the value <g> of 0.83 and included in the high category. This can be caused because of the average score pre-test students on applying aspects including smaller in among another aspect. After the students are trained to be able to determine the exact equations in solving presented at each meeting, the result shows an increase in the aspect of applying is bigger than others. The improvement the highest on aspects of cognitive learning achievement in experiments class using PhET simulation is aspects of the memorizing with <g> of 0.73 and included in the high category. This is due, the pre-test and post-test scores of students on memorizing aspects are higher than other cognitive aspects. Besides, students still remember various concepts related to harmonious motion that is widely applied in tools found in everyday life.

The lowest increase in class experimental using KIT media of cognitive learning achievement occurred in the creative aspect with <g> equal to 0.67 and included in the medium category. The same result was also shown in the experimental class using the PhET simulation. The creative aspect shows the lowest increase compared to other aspects with <g> equal to 0.53 including the medium category. It can be caused by many students who haven't been able to find a solution or alternative answers that allow them to solve the worksheet. Besides, the aspect of creating only trained by giving the possibility of a result that happened on the issue presented in the problem question. Another aspect more trained at each step the student worksheet.

The hypothesis test results using a t-test before using KIT media and PhET simulation show no difference a significant student's cognitive learning achievement use media KIT with PhET simulation on harmonic oscillation. Then to test hypotheses after implementation KIT media and PhET simulation show there is a significant difference in the outcome of cognitive learning of students use KIT media with PhET simulation on simple harmonic oscillation. This can be caused because during the process of learning students are trained to be able to resolve problems that are presented on the student worksheet using cognitive learning results indicators are supported with the use of the KIT media and PhET simulation. This previous research with that doing by Johnson-Glenberg & Megowan-Romanowicz (2017) which says that there is the influence of the use of KIT media to increased student learning outcomes on the material thermal energy. The cognitive learning achievement of students included in the category very strongly with implementation learning with virtual media are supporting by PhET simulation (Ajredini *et al*, 2017; Jauhari *et al*, 2017; Randall & Emily, 2016).

The students' be familiarized to be able to resolve the issue systematically so that the solution given is the conclusion from the results of each step of troubleshooting is done (Weatherspoon *et al*, 2015). Based on some previous research and the results of research conducted, it can be concluded that KIT media, as well as PhET simulation, could be made as an alternative to improve student's cognitive learning achievement students. Furthermore, if results from improving student's cognitive learning achievement using KIT media compared to the PhET simulation then it can be seen the value <g> on the class using KIT media is greater than PhET simulation. So, it can be concluded the use of media KIT is better in enhancing cognitive learning achievement of students compared with the PhET simulation in the topic oscillation harmonic.

CONCLUSION

We have succeeded in conducting research to determine which one the better of using a hand on in the form of KIT media and PhET simulations in improving student learning achievement in the topic oscillation harmonic. The implementation of the scientific approach learning using a hand on in the form of KIT media and PhET simulation at each meeting was done well. The average implementation of the scientific approach learning in an experimental class using KIT media for teacher activities i.e., 82% and student activities i.e., 76% both of activity include good a category. The enhancement of cognitive learning achievement of students in harmonic oscillation after using KIT media obtained an average value of normalized gain <g> 0.78 includes the high category. The average implementation of the scientific approach learning using PhET simulation to the activities of the teacher that is 80% with a good category and student activities 72% with category middle. The enhancement of cognitive learning achievement of students in harmonic oscillation after using PhET simulation obtained an average value of normalized gain <g> 0.64 includes the medium category. There are some suggestions that were proposed as a reference for further research, namely at the stage communicating from the scientific approach learning a teacher should provide motivation to help build the confidence and courage of the students in the says opinion and public speaking. The use of virtual media considering computer facilities and internet access

are adequate to smooth on the learning process. The topic of physics which contains many concrete concepts is better to use a hand on in the form of KIT media than using simulation. The problem served in aspect creating, should be presented with an interesting discourse so that the students can understand the problems faced and found solutions to complete the problem.

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