The Influence of the Learning Cycle 5E Teaching Model Assisted by PhET Media on Students' Learning Outcomes in the Subject of Elasticity and Hooke's Law

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Abstract *- This study aims to determine the effect of the learning cycle 5e learning model assisted by PhET media on student learning outcomes in the subject matter of elasticity and Hooke's law. The research was conducted at SMA Negeri 1 Tapa in class XI during the odd semester of the 2022/2023 academic year, with a population of students in class XI IPA. The research subjects were class XI IPA 1 as the experimental class and XI IPA 2 as the control class, totaling 42 people. XI IPA 1 was taught using a learning cycle model assisted by PhET media, while XI IPA 2 was taught using a conventional learning model. The method used in this study was an experimental method with a research design using a pretest-posttest control group design. The variables in this study were independent and dependent variables. The instrument used was a written essay test to measure the level of student learning outcomes on elasticity and Hooke's law. Sampling in this study was done using a cluster random sampling technique. The data analysis techniques used in this research included data normality test, homogeneity test, hypothesis test, and n-gain test. The results showed that the average pretest value in the experimental class was 43.6, while in the control class it was 37.7. After treatment in each class, the posttest average values were 69.6 in the experimental class and 58.1 in the control class. Based on the results of testing the hypothesis, it was found that tcount = 6.26 ≥ ttable = 2.02, indicating that H0 was rejected and H1 was accepted. This demonstrates that learning using the learning cycle 5e learning model assisted by PhET media has a significant effect on student learning outcomes. The increase in student learning outcomes can be seen in the n-gain test analysis, with the experimental and control classes obtaining scores of 0.6 and 0.5 respectively, indicating moderate n-gain criteria. This means that the treatment given has an influence on student learning outcomes.*

Keywords*: Learning Cycle 5E; PhET; Learning Outcomes*

INTRODUCTION

Education plays a crucial role in the progress of a nation and a country. Through education, individuals grow and develop into good individuals. Education can be seen as a process in which individuals acquire knowledge, understanding, and appropriate behavior.

Education holds a significant role in a nation's development because education's success will significantly influence development in other fields. With the advancement of science and technology, the demand for education is increasing. Therefore, to improve students' abilities and quality in line with educational goals, the education sector must be able to adapt to the current conditions and developments. Education is also one aspect of human life that is influenced by the development of science and technology.

Physics learning is still dominated by conventional methods such as lectures. The reason for still using this model is the limited availability of physics laboratories in schools, both in quantity and quality. Educators are required to use various teaching models to achieve the goals of education. The role of educators is crucial in the learning process as they motivate learners. There are many ways to motivate learners to develop leadership characteristics, including paying attention to and learning from criticism and

implementing appropriate teaching models in the learning process (Hariyadi et al., 2016).

Based on observations conducted at SMA Negeri 1 Tapa, several problems have been identified, including low student learning outcomes. It is known that students pay less attention to the teacher during the explanation of materials, need help understanding the concepts, and find physics lessons boring because teachers still use conventional teaching methods that are teacher-centered, which means students are not actively involved in the learning process. Therefore, using instructional media is necessary to support the learning process, allowing students to play an active role and improve their learning outcomes.

One way to address the issues that arise and motivate learners to support the learning process is by using a suitable teaching model and instructional media for physics, such as the learning cycle model and PhET media. The learning cycle model is a student-centered teaching model that consists of organized activities, including experimental methods, where students discover knowledge through observation, note-taking, analysis, and concluding from practical activities. Using this model, students can better understand the subject matter and stimulate their thinking abilities.

Arindawati, as cited by Siti Djumhuriyah (2008), stated that the learning cycle model originally consisted of three stages: exploration, concept interdiction, and concept application. These three stages have since evolved into five stages: engagement, exploration, explanation, elaboration, and evaluation. According to Ngalimun (2014), the advantages of this model are increased learning motivation as students actively engage in the learning process. However, its effectiveness is reduced if teachers have a poor grasp of the subject matter and the steps of the teaching process.

Instructional media, on the other hand, are tools used to deliver learning materials. Their use can enhance students' learning enthusiasm and promote their active participation. One such medium is PhET. PhET is a simulation media developed by the University of Colorado, offering physics, biology, and chemistry learning simulations. PhET emphasizes the connection between real-life phenomena and the underlying science, supports interactive and constructive approaches, provides feedback, and offers a creative workspace (Wiravanjaya, 2017). PhET media can captivate students' interest and motivate them to conduct experiments, improving their learning outcomes (Prihatiningtyas et al., 2013).

This research combines the learning cycle 5e teaching model with PhET instructional media. It ensures that students can remember the material they have learned in every learning process, thus enhancing their learning outcomes. As Ngatiatul Mabsuthoh (2010) explained in their study, the learning cycle 5e teaching model impacts physics learning outcomes in the concept of density. Research conducted by Eva and Harin (2012) also indicated that using the experimental-based learning cycle model affects students' learning outcomes on the topic of substances and their states.

Based on the description, this research aims to measure the impact of the Learning Cycle 5E teaching model assisted by PhET media on student learning outcomes.

RESEARCH METHODS

This research employs an experimental method with a pretest-posttest control group design. Experimental research can be defined as a research method used to determine the influence of a specific

treatment on something under controlled conditions. This study examines the impact of the Learning Cycle 5E teaching model assisted by PhET media on student learning outcomes.

The test used in this research is a cognitive test in the form of essay questions that had validated by validator. This test is administered in both the experimental and control groups before the learning process (pretest) and after the learning process (posttest).

The data collection technique used in this research is a written test. Prior to conducting the study, the instruments used undergo a validation process. Thus, the instrument used to collect data in this research is a written test in the form of essays. The test consists of a pretest and a posttest to measure students' learning outcomes in the cognitive domain. The data analysis techniques were tests for data normality, homogeneity, hypothesis, and n-gain.

The normality test of data aims to determine whether the data to be analyzed is normally distributed or not. The decision-making process is based on the value of l (l_{calc}). If the value of lcalc is greater than the table value (l_{table}), then H_0 is rejected, and if the value of lcalc is less than the table value, then H_1 is accepted.

The statistical test used for the normality test is the Lilliefors test, with a significance level of $\alpha = 0.05$, as follows:

$$Z_i = \frac{X_i - R}{S} \qquad (1)$$

Hypothesis statistic:

H_0 = normalized data

H_1 = unnormalized data

(Murwani, 2001)

The purpose of testing data homogeneity is to determine whether the ability of the characteristics of the two classes is homogeneous. This homogeneity test uses the F-test as follows:

$$F_{count} = \frac{greater\ varians}{lower\ varians}$$

Criteria:

$F_{count} < F_{table}$ = Homogeneous sample

$F_{count} > F_{table}$ = non-Homogeneous sample

(Novalia, 2013)

The hypothesis testing used is to determine the difference in the means between the two groups. This test utilizes the t-test statistic, as follows:

$$t_{hitung} = \frac{M_1 - M_2}{\sqrt{\frac{SS_1 + SS_2}{n1+n2-2}\left(\frac{1}{n1}+\frac{1}{n2}\right)}} \qquad (2)$$

(Nuryadi et al., 2017)

The n-gain test is conducted to assess the extent of student learning improvement by calculating the pretest and posttest values using the following formula:

$$N - gain = \frac{posttest\ score - pretest\ score}{Score\ max - Score\ pretest}$$

After performing the calculations, the obtained results are then interpreted based on the criteria in Table 1.

Table 1. The criteria for grouping n-gain

N-Gain	Category
g > 0,70	High
0.,30 < g < 0,70	Moderate
g > 0,30	Low

RESULTS AND DISCUSSION

Results

The research data obtained the average learning outcomes for both classes, which can be seen in Table 2.

Table 2. Average Score of pretest and posttest

Group	Average Score of pretests	Average Score of posttests
Experiment	43,6	69,6
Control	37,7	58,1

Based on Table 2, it can be observed that the average pretest and posttest scores of both classes differ. The experimental class

has the highest average score. It indicates an improvement in learning outcomes before and after the instruction. Therefore, it demonstrates that implementing the learning cycle 5E model aided by PhET influences student learning outcomes.

The normality test determines whether the obtained data follows a normal distribution. The normality test uses the Lilliefors test. The results of the normality test can be seen in Table 3.

Table 3. Results of Data normalized test

Group	l_{count}	l_{table}	Status
Experiment	0,14	0,18	Normal Distributed
Control	0,08	0,18	Normal Distributed

Based on Table 3, it shows that both the experimental class and the control class have $l_{hitung} \leq l_{tabel}$ at a significance level of $\alpha = 0.05$. Therefore, it can be concluded that the obtained data for both classes follow a normal distribution.

After confirming that both datasets are normally distributed, the next step is to test for homogeneity in both classes. Homogeneity testing is performed using the Fisher test. The results of the homogeneity test can be seen in Table 4.

Table 4. Homogeneity test results

Group	F_{count}	F_{table}	Status
Experiment & Control	0,469	2,124	Homogeny

Based on Table 4, it is shown that the learning outcome data groups have $F_{count} \leq F_{table}$ at a significance level of $\alpha = 0.05$. This indicates that both groups of learning outcome data are derived from homogenous populations.

Hypothesis testing is used to determine whether the treatment has an effect on student learning outcomes. The hypothesis testing utilizes the t-test, and the results of the hypothesis testing can be seen in Table 5.

Table 5. Hypothesis Test Result

Group	t_{count}	t_{table}	Status
Experiment & Control	6,26	2,02	H_0 rejected

Based on Table 5, it is shown that $t_{count} \geq t_{table}$ at a significance level of $\alpha = 0.05$. Specifically, $6.26 \geq 2.02$. This indicates that the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_1) is accepted.

The n-gain test is conducted to assess the improvement in student learning outcomes in the class through the pretest and posttest. The results of the n-gain test can be seen in Table 6.

Table 6. N-Gain Test for Learning Outcome

Group	N-gain score	Criteria
Experiment	0,4	Moderate
Control	0,3	Moderate

Based on Table 6, it is obtained that the n-gain value in the experimental class is higher compared to the control class. It can be concluded that the improvement in student learning outcomes in both classes falls within the moderate criteria.

Discussion

The student learning data in this study was obtained through essay-type learning outcome tests. The essay tests were administered to students in the experimental and control groups before the treatment (pretest) and after the treatment (posttest).

Based on Table 2, which presents the average pretest and posttest scores obtained from the experimental and control groups before and after the treatment, it is evident that the pretest and posttest results in the experimental group have higher average scores than the control group. It indicates

that using the 5E learning cycle model aided by PhET media can improve students' learning abilities. The pretest results for the experimental group showed an average score of 43.6, and after the treatment involving the learning cycle 5E, the average posttest score increased to 69.6. On the other hand, the control group had an average pretest score of 37.7, and after the treatment involving conventional teaching methods, the average posttest score increased to 58.1. These results demonstrate that the average student learning outcomes regarding elasticity and Hooke's law in the experimental group are higher compared to the control group. It indicates the influence of the learning cycle 5E model on student learning outcomes. These findings are consistent with the research presented by Nugraheni (2016), which states that using the 5E learning cycle model significantly impacts physics learning outcomes in the concept of density. Another study by Wicaksono (2017) also suggests that using the 5E learning cycle model in physics learning to enhance students' understanding of static fluids is appropriate and can be implemented in teaching.

This learning model actively involves students in the learning process, making it easier for students to comprehend and deepen their understanding of the concepts being taught. These concepts are well embedded in students' memory, enabling them to recall the knowledge in future situations.

Selecting an appropriate learning model is one of the factors contributing to the success of teaching and learning activities. Therefore, in this study, implementing the learning cycle 5E model allows students to be more actively involved in the learning process and reduces their dependence on the teacher, thus motivating students in the learning process.

The use of PhET media in this study also contributes significantly to the final learning outcomes. This media increases student interest in learning by presenting technology-based platforms such as laptops/computers. PhET simulations enhance students' enthusiasm for learning as the simulations emphasize the connection between real-life events and the learned scientific principles. PhET simulations are developed to assist students in understanding abstract concepts in learning (Uloli, 2022). Additionally, according to Abdjul and Ntobuo (2018), using PhET simulations improves students' activity and learning outcomes during the learning process.

However, some challenges were encountered during the learning process, such as some students needing to be more active in the classroom. There was a lack of interaction among students within their groups, and some students worked individually without discussing with their peers. To address these challenges, the researcher emphasized applying the learning cycle model to encourage students to actively participate in the learning process (Emilio, 2011). According to Agustyaningrum (2011), implementing the learning cycle has several benefits, including student-centred learning, connecting new information with students' existing knowledge, meaningful learning, and avoiding traditional memorization-based learning methods.

To determine whether the treatment involving the learning cycle 5E model aided by PhET has an impact on student learning outcomes, the researcher conducted a hypothesis test and obtained $t_{count} \geq t_{table}$ for a significance level of $\alpha = 0.05$. Thus, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted. It can be observed in Table 5, where the calculated t_{count} (6,26) $\geq$ t_{table} (2,02),

indicating that the treatment affects physics learning outcomes.

N-gain testing was conducted to assess the improvement in student learning outcomes in the experimental and control groups. The n-gain value obtained for the experimental group was 0.4, and for the control group, it was 0.3. Therefore, the n-gain analysis for both groups fall within the moderate range.

CONCLUSION

Based on the research results, there is an influence of the learning cycle 5E model aided by PhET media on student learning outcomes. It is supported by the average pretest score of 43.6 and the average posttest score of 69.6.

Based on the study's findings, the researcher suggests several recommendations that could be considered for future improvements. Implementing the learning cycle 5E model aided by PhET media can assist and facilitate teachers in conducting learning activities. Through this approach, students' learning outcomes can improve, and they can develop their knowledge, which in turn impacts their learning outcomes.

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REFERENCES

Abdjul, T., & Ntobuo, N. (2018). Developing Device of Learning Based on Virtual Laboratory through Phet Simulation for Physics Lesson with Sound Material. *International Journal of Sciences: Basic and Applied Research (IJSBAR)*, *39*(2), 105–115. Retrieved from https://www.gssrr.org/index.php/JournalOfBasicAndApplied/article/view/9002

Agustyaningrum, N. (2011). Implementasi Model Pembelajaran Learning Cycle 5e untuk Meningkatkan Kemampuan Komunikasi Matematis Siswa Kelas Xi B SMP Negeri 2 Sleman. Jurnal Prosiding, 1.

Hariyadi, D., Ibrohim, I., & Rahayu, S. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Lingkungan Terhadap Keterampilan Proses Dan Penguasaan Konsep Ipa Siswa Kelas VII Pada Materi Ekosistem. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 1*(8), 1567—1574. doi:http://dx.doi.org/10.17977/jptpp.v1i8.8891

Emilio, et al., (2006). A Learning Cycle for All Students. Mankato: Minnesota State University.

Murwani, S. (2011). Statistika Terapan (Teknik Analisis Data). Universitas Negeri Malang.

Ngalimun. (2014). Strategi dan Model Pembelajaran. Yogyakarta: Aswaja Pressindo.

Novalia. (2013). Olah Data Penelitian Pendidikan. Bandar Lampung: Anugrah Utama Rahaja.

Nugraheni, L. S. (2012). Pengaruh Penerapan Model Pembelajaran Learning Cycle (5E) Terhadap Keterampilan Proses Sains Biologi Siswa Kelas X SMA Al Islam 1 Surakarta. Repository UNS.

Nuryadi Astuti. T. D. Utami, E. S., & Budiantara M. (2017). Buku Ajar Dasar-dasar Statistika Penelitian.Yogyakarta: Sibuku Media.

Prihatiningtyas, S., Prastowo, T., & Jatmiko, B. (2013). Imlementasi Simulasi Phet Dan Kit Sederhana Untuk Mengajarkan Keterampilan Psikomotor Siswa Pada Pokok Bahasan Alat Optik. *Jurnal Pendidikan IPA Indonesia, 2*(1).

doi:https://doi.org/10.15294/jpii.v2i1.2505

Siti Djumhuriyah. (2008). Penggunaan Model Pembelajaran Learning Cycle untuk Meningkatkan Ketuntasan Belajar Siswa pada Konsep Pemuaian di Kelas VIID SMP Negeri 8 Bogor. Tersedia di www.docstoc.com.

Wicaksono, I., Jatmiko, B., & Prastowo, T. (2017). Pengembangan Perangkat Pembelajaran Fisika Model Learning Cycle 5E Untuk Meningkatkan Pemahaman Konsep Siswa Pada Materi Fluida Statis. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *4*(2), 518–524. https://doi.org/10.26740/jpps.v4n2.p518-524

Wiravanjava, W. (2017). Pengaruh Penerapan Metode Eksperimen Menggunakan Phet Simulation Terhadap Kemampuan Berpikir Kritis dan Hasil Belajar Ditinjau dari Pengetahuan Awal Siswa SMP/MTs. *Prosiding SNFA (Seminar Nasional Fisika dan Aplikasinya), 2*, 269-275. doi:http://dx.doi.org/10.20961/prosidingsnfa.v2i0.16410

Uloli, R. (2022). Pelatihan Pembuatan Media Pembelajaran IPA Berbasis Simulasi PHET Dengan Model Discovery Learning Bagi Guru Sekolah Menengah Pertama Di Desa Popalo Kecamatan Anggrek. *Jurnal Sibermas (Sinergi Pemberdayaan Masyarakat)*, *11*(4), 858-867. doi: https://doi.org/10.37905/sibermas.v11i4.12339