JoSSEd
Journal of Science and Science Education
ISSN: 2774-1869 eISSN: 2774-2105

Training High School Students' Science Process Skills Through Phet Media in the Inquiry Model on Elasticity Material

Fryan Sopacua[1], Venty Sopacua[1*]

[1] Physics Education Study Program, Faculty of Teacher Training and Education, Pattimura University, Indonesia.

Received: August 21, 2024
Revised: October 17, 2024
Accepted: October 25, 2024
Published: October 31, 2024

Corresponding Author:
Venty Sopacua
givensohilait@gmail.com

DOI: 10.29303/jossed.v5i2.9546

Abstract: This study aims to train the science process skills of high school students through phet media in an inquiry setting on elasticity material. The sample of this study was 27 students of class XI MIA-3. This study uses quantitative and qualitative descriptive research types. The trial design uses one group pretest–posttest design. The instrument in this study is the Test Instrument, in this case to measure the increase in students' science process skills before and after treatment using the inquiry model and phet media. Data analysis in this study was carried out using quantitative descriptive analysis. The data analysis technique used is qualitative descriptive analysis including: the results of the science process skills test. The results showed an increase in science process skills with an average Ngain of 0.80 with a high category and the achievement of an increase in each science process skill indicator above 70%, so it can be concluded that the inquiry model and phet media can train the science process skills of SMA A class XI MIA-3 students on elasticity material.

Keywords: Science Process Skills; Phet Media; Model on Elasticity Material

Introduction

Natural Sciences (IPA) or science is a science that studies natural phenomena including living things and non-living things or science about life or science about the physical world. Science was born and developed from observation and experimentation. Science has two important aspects, namely knowledge and methods in obtaining the knowledge itself (Sutrisna et al, 2022). Science education is a series of learning activities carried out by educators together with students with the aim of improving students' thinking skills and building new knowledge as an effort to strengthen good mastery of science material (Astuti, 2019). In the science learning process, science process skills become essential skills because with these skills, science learning objectives can be achieved through scientific inquiry-based activities (Rustaman et al., 2005) so that students experience scientific events directly.

Science process skills are a collection of directed skills used to build and form knowledge concepts from an event or natural phenomenon through observation skills, interpreting, predicting, experimenting, and providing explanations or conclusions from the results of the experimental proof (Kurniansah et al., 2023). In line with research (Murniati et al., 2021) that science process skills are the ability to apply scientific methods to understand, develop scientific concepts, and discover new knowledge, which are related to psychomotor, cognitive, and affective skills. Science process skills are provisions for students in participating in science learning, which will also be useful in everyday life. Science process skills are basic competencies in the learning process by prioritizing the ability to acquire knowledge and communicate what has been obtained (Fitriani et al., 2021; Wiratman et al., 2021). Science process skills are needed by students to face a world dominated by science and technology (Jaya et al., 2022; Yalçınkaya-Önder et al., 2022), so science process skills are very important for students in science education as shown by the relationship between science process skills and students' academic achievement (Dolapcioglu & Subası, 2022; Senisum et al., 2022; Sideri & Skoumios, 2021).

How to Cite:
Sopacua, F., & Sopacua, V. (2024). Training High School Students' Science Process Skills Through Phet Media in the Inquiry Model on Elasticity Material. *Journal of Science and Science Education*, *5*(2), 133–138. https://doi.org/10.29303/jossed.v5i2.9546

Based on the results of interviews with teachers at SMA A in Ambon City, it was found that science process skills had been applied, including indicators of observing, collecting information and communicating for indicators of determining investigation variables, formulating problems, formulating hypotheses, interpreting data and making conclusions based on hypotheses and problem formulations had not been trained or emphasized. The conclusions made were usually general conclusions of learning. In addition, SMA A lacked LAB equipment to conduct experiments so that a learning medium was needed that could make students practice their science process skills when conducting experiments. One of the media that can be used is through the Phet simulation media.

PhET is a pioneer of website-based simulations developed by experts from the University of Colorado Boulder to help students learn through simulation learning (Nizar et al, 2022). Based on research by Ouahi et al (2022), the advantages of PhET are that the use of interactive simulations is very effective in science learning. PhET is a user-friendly simulation, moving images (animation), interactive, interesting, and designed like a game, making it easier for students to understand the material being studied (Ekawati et al, 2020). PhET simulations make real phenomena and physical concepts easy for students to understand. In line with that, according to Sylviani (2020), PhET Simulation is based on simulations that are easier for students to use by presenting activities with visualization of objects, images, and numbers. The use of Phet media must be supported by a learning model that emphasizes science process skills. The learning model is the inquiry learning model.

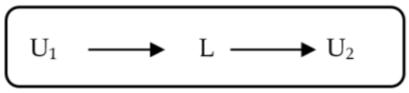
Inquiry learning is one of the learning models used by teachers in carrying out learning activities. In this model, students are encouraged to actively ask questions and discover their own knowledge. In its application, this model requires higher thinking skills in students than other models. In line with the opinion of (Andriani & Nirmawan, 2022) that the inquiry learning model is a learning model that prioritizes high-level thinking. In inquiry learning, student activity is the main key to learning because in this model students are not only required to ask questions, but students also have the right to answer questions or problems that are questioned in the learning material. In (Parnawi & Alfisyahrin, 2023) it is also stated that the inquiry-based learning model is a series of learning activities that emphasize critical and analytical thinking to find and find answers to a problem in question. The advantages of inquiry learning include (1) inquiry learning emphasizes the aspects of knowledge, attitudes, and skills in a balanced manner. (2) inquiry learning is able to create space for students to learn with their learning style. (3) This learning can serve students who have above average abilities. (4) Inquiry is a method that is considered most appropriate to the development of psychology, modern learning which considers learning to be a process of changing behavior thanks to experience (Nurianto Ramadhani & Herniati SDN Srondol Wetan, 2023).

Based on the background description above, the author researches "Training High School Students' Science Process Skills through Phet Media in Inquiry Model Settings on Elasticity Material".

Method

Research Design

This study uses quantitative and qualitative descriptive research types. The research design used in this study is one group pretest posttest design. Arikunto (2010) said that one group pretest-posttest design is a research activity that provides an initial test (pretest) before being given treatment, after being given treatment then giving a final test (posttest).This design can be written as follows (Prabowo, 2011):



Information:

U1 is : Pretest to determine students' initial science process skills abilities in elasticity material.
U2 is : Posttest to determine the final ability of students' science process skills on elasticity material.
L is : Providing Inquiry Models.

Participant

The population of SMA A consists of 3 classes in class XI with a population of 87 students. The type of sample used is a purposive sample based on the average previous Physics results, so that the research sample can be drawn, namely class XI MIA-3 consisting of 27 students.

Research Instruments

The instrument in this study is a test instrument, the science process skills test instrument consists of 10 PG test questions and 3 essay questions.

Research Procedures

The research procedures include: (1) Initial observation, (2) Preparation of research instruments, (3) Instrument validation, (4) Research, (5) Reflection, (6) Preparation of reports, (7) Revision, (8) Final report and (9) Journal.

Data Analysis Techniques

Data analysis in this study was conducted using quantitative descriptive analysis to describe the data as it is in the form of percentages and explain data or events with explanatory sentences qualitatively. Data analysis techniques used include: qualitative descriptive analysis, namely improving the ability of science process skills. The increase in science process skills was measured using normalized gain analysis adapted from Hake's (1999) normalized gain formula (Formula 1).

$$< g > = \frac{(S_{Post}) - (S_{Pre})}{\text{Skor Maksimal} - (S_{Pre})} \quad (1)$$

Information:

g is :	Improvement (average normalized gain).
Spre is:	Pretest Score.
Spost is:	Prottest Score.

Table 1. N-Gain Score Distribution

N-Gain Value	Category
$\mathbf{g > 0.7}$	Tall
$\mathbf{0.3 \leq g \leq 0.7}$	Currently
$\mathbf{g < 0.3}$	Low

Result and Discussion

Science process skills tests were given before and after science process skills were trained during the teaching and learning process. The initial science process skills test was given before the teaching and learning activities took place using an inquiry model to determine the extent of students' knowledge of science process skills. While the final science process skills test was to determine the extent to which students had absorbed knowledge after teaching and learning activities using an inquiry model. The results of science process skills training in the study were measured using the N-gain and conventional formulas with a sample size of 27 students in class XI MIA-3, presented in Figure 1.1 and Figure 1.

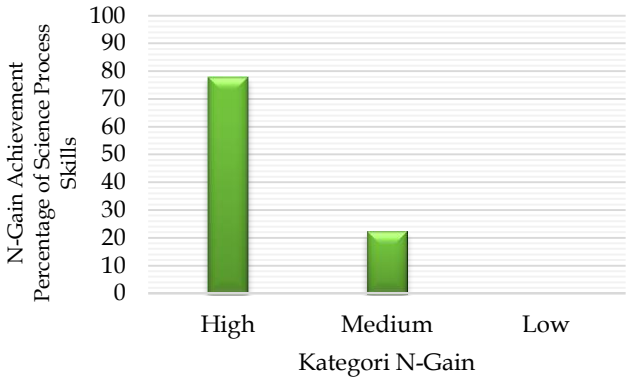


Figure 1. N-Gain Results of Science Process Skills

Based on Figure 1, it was found that out of 27 students, 21 or 77.78% of students had a high category in improving science process skills and 7 or 22.22% of students had a medium category and students who had a low category were 0%. The application of the inquiry model with Phet media can improve students' science process skills. with an average N-gain of 0.80 in the high category (Hake, 1999). This is because students in class XI MIA-3 like the use of Phet in the elasticity of materials material, so that students feel comfortable and happy in physics learning based on Phet Simulation. In addition, learning using the inquiry model is felt to be able to help students directly to practice science process skills.

According to Andriani & Nirmawan, (2022) that the inquiry learning model is a learning model that prioritizes high-level thinking. In inquiry learning, student activity is the main key to learning because in this model students are not only required to ask questions, but students also have the right to answer questions or problems that are questioned in the learning material. One of the characteristics of the inquiry model is that students are able to find a concept themselves from a high-level and analytical thinking process. Science process skills are skills that make students think at a high level. In Figure 1, the N-Gain value is determined by the pretest and posttest results. The pretest results obtained by all students in Class XI MIA-3 got below average scores and when trained with the inquiry model through the Phet Simulation media, the posttest results of students increased from the pretest results so that the NGain value of students was in the medium-high category. This increase is because during the learning process it is supported by inquiry-based LKPD which can train science process skills. LKPD has an important role in a learning process. Through LKPD, students can train science process skills by following examples and guidance that researchers have poured into LKPD.

Student Worksheets (LKPD) are learning media in the form of sheets containing assignments, instructions for carrying out assignments, and learning evaluations that must be completed by students, arranged based on the basic competencies that need to be achieved. (Pawestri & Zulfiati, 2020). LKPD includes various activities that must be carried out by students to maximize their understanding and form basic skills according to the learning outcome indicators that must be achieved (Ansori, 2020). Student Worksheets (LKPD) consist of tasks that must be completed by students, such as questions and other work. LKPD encourages students to be active in seeking information. In filling out LKPD, it is given in groups with the aim that students can learn from their peers. Students need support from peers because when at school students interact more often,

exchange ideas, and solve problems with their peers (Oktaiani & Perianto, 2022).

According to Ratnasari, (2017) when students associate with a group of peers who have a high curiosity, then the students will be influenced by the group of their peers so that they provide positive support to each other. Conversely, if students associate with a group of peers who have low curiosity or are lazy, it is likely that students will be influenced to be lazy. For that, when dividing the group, it is divided homogeneously. The success of improving science process skills is in line with the test results seen per indicator in Figure 2, after learning using the inquiry model and Phet media.

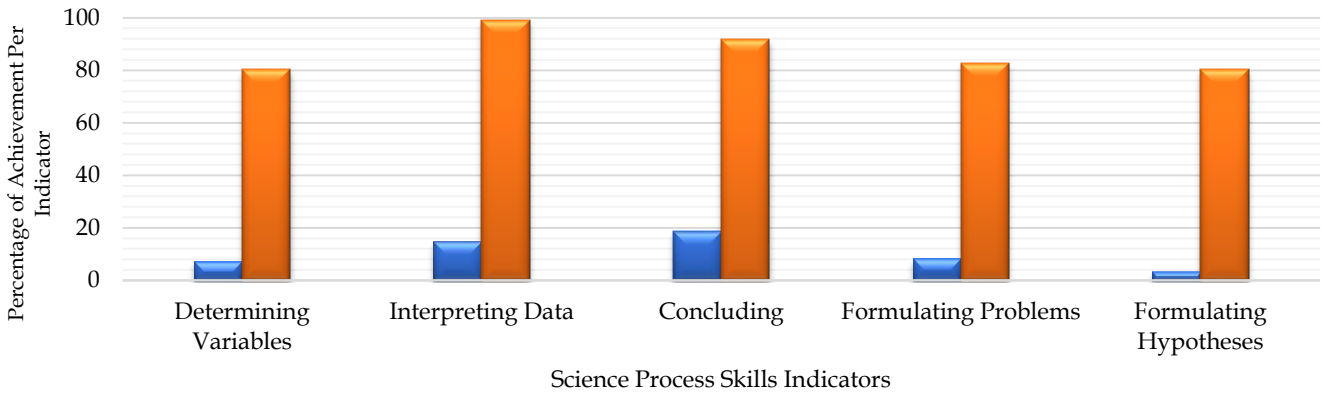


Figure 2. Science Process Skills Results Per Indicator

Based on Figure 2, it was found that there was an increase in each indicator of science process skills with an average achievement of 76.6%. The first indicator, Determining Variables, had an increase in achievement of 72.8%, because in determining variables, students were given an explanation of the relationship between variables and examples that could guide students to determine control, response, and manipulation variables so that students could distinguish each variable. Margono (1997) stated that a variable is a concept that has a variety of values. This means that this variable certainly has various properties and refers to different characteristics between one variable and another.

The second indicator of interpreting data has an increase in achievement of 84.25%, because in interpreting data students have conducted experiments using the Phet Simulation application, where data such as the value of the increase in length is already listed in the application at the time of measurement, but students must do calculations to measure strain, stress, and young's modulus. Before students calculate the values of strain, stress, and young's modulus for each manipulation variable, the researcher has explained the formula that will be used and how to calculate it. The data obtained is made into a graph of the relationship between the increase in length and tensile force. According to Inayah, et al. (2024) stated that data interpretation skills usually begin with collecting or collecting data and describing the data. Describing data can be interpreted as presenting data in a form that is easy to understand, such as data made in the form of tables or graphs. Interpreting data is a process that refers to the intrinsic ability to recognize patterns and associations in data.

The third indicator, concluding, has an increase in achievement of 74.38%, because concluding must be based on the hypothesis or temporary assumption that has been made. Students draw conclusions based on the hypothesis and data that has been obtained. In concluding, students already know the core concept of the material. The indicator of science process skills concluding refers to students' ability to make generalizations or inferences from data or information that has been obtained through observation, experiments, or research. This skill involves critical analysis and synthesis of information to formulate logical conclusions supported by evidence. Concluding is important in science education because it helps students develop critical and analytical thinking skills, and apply scientific methods in understanding the world around them (Hamdani, 2019).

The fourth indicator of Formulating Problems has an increase in achievement of 74.38%, because in formulating problems, students must know that the formulation of problems in the form of questions contains manipulation variables and response variables. These two variables must be included in the formulation of the problem so that when formulating the problem, students do not have difficulty in formulating the problem. In addition, students are guided to formulate problems. According to Lincoln, et al. (1985), problem formulation is not just a question, but is a condition or state that occurs due to the interaction of two or more

factors that result in confusing conditions, conflict, and something undesirable.

The fifth indicator of formulating a hypothesis has an increase in achievement of 76.85%, because in formulating a hypothesis, students associate it with the formulation of the problem made and in the formulation of the problem there are manipulation and response variables that will also be included in the hypothesis. Students must also know that the hypothesis is made in the form of a statement. According to Fitriana, et al. (2019) said that in making a hypothesis, students need basic knowledge about the thing to be studied and requires students to have the ability to solve a problem. According to Widodo (2023), the indicator of predictive science process skills is essential in shaping students' scientific thinking, helping to develop various cognitive and practical skills that are important for further scientific study and application in everyday life.

Conclusion

Based on the findings in the results and discussion, it can be concluded that the inquiry model and phet media can train the science process skills of high school students on elasticity material with an average Ngain of 0.80 with a high category and the achievement of increasing each indicator of science process skills above 70%. Suggestions that can be given are that other researchers can conduct further research on science process skills at the high school level.

Acknowledgements
We would like to thank all parties involved in this research who have taken the time and thought to support this research, especially the Physics Education Study Program, Pattimura University, Ambon.

Author Contributions
All authors have real contributions in completing this manuscript.

Funding
This research received no external funding

Conflicts of Interest
The authors declare no conflict of interest.

References

Andriani, N., & Nirmawan, N. (2022). The Influence of the Inquiry Learning Model in Writing Complex Procedure Texts on Grade XI Students. *Prima Magistra: Scientific Journal of Education*, 3(2), 180–187.https://doi.org/10.37478/jpm.v3i2.1471

Ansori, YZ (2020). Character Building of Students Through Integrated Learning in Elementary Schools. *Jurnal Educatio FKIP UNMA, 6(1), 177*–186. https://doi.org/10.31949/educatio.v6i1.308

Arikunto, S. (2010). Research Procedures: A Practical Approach. Jakarta: Rineka Cipta.

Astuti, TP (2019). Problem Based Learning Model with Mind Mapping in 21st Century Science Learning. *Proceeding of Biology Education*, 3(1), 64–73.https://doi.org/10.21009/pbe.3-1.9

Dolapcioglu, S., & Subası, M. (2022). The Relationship between Scientific Process Skills and Science Achievement: A Meta-Analysis Study. *Journal of Science Learning,* 5(2), 363–372. https://doi.org/10.17509/jsl.v5i2.39356

Ekawati, Y., Abdul Haris, & Hj. Bunga Dara Amin. (2020). Application of Simulation Media Using PHET (Physics Education And Technology) on Physics Learning Outcomes of Grade X Students of SMA Muhammadiyah Limbung. *Journal Of Physics Education, Muhammaddiyah University Of Makassar*, 3(1), 1–9. https://doi.org/https://doi.org/10.26618/jpf.v3i1.254

Fitriana, Kurniawati, Y., & Utami, L. (2019). Analysis of Students' Science Process Skills on Reaction Rate Material Through the Bounded Inquiry Laboratory Learning Model. *Jurnal Tadris Kimiya,* 4(2), 226-236.

Fitriani, R., Chen, D., Maryani, S., Aldila, FT, Aktapianti, A., Ginting, B., Sehab, NH, & Wulandari, M. (2021). Describing Students' Science Process Skills through Viscosity Practical Activities at SMAN 1 Muaro Jambi. *PENDIPA Journal of Science Education*, 5(2), 173–179. https://doi.org/https://doi.org/10.33369/pendipa.5.2.173-179

Hake, R.R. (1999). *Analyzing Change/Gain Scores.* Dept. of Physics Indiana University. Downloaded fromhttp://www.physics.indiana.edu

Hamdani, M., Prayitno, BA, Karyanto, P. (2019). Improving Critical Thinking Skills Through Experimental Methods. *Proceeding Biology Education Conference,* 16(1), 139 - 145.

Inayah Wardah Syafiqah, Arie Arma Arsyad, Ramlawati. (2024). Analysis of Science Process Skills of Grade VIII Students of A-Accredited Junior High Schools in Rappocini District. *Journal of Education and Learning*. 4(1)

Jaya, TD, Tukan, MB, & Komisia, F. (2022). Application of Guided Inquiry Approach to Train Students' Science Process Skills in Buffer Solution Material. *Educativo: Journal of Education,* 1(2), 359–366. https://doi.org/https://doi.org/10.56248/educativo.v1i2.44

Kurniansah, E., Masfuâ, S., & Roysa, M. (2023). Analysis of science process skills of grade 4 students of SD 03 Pecangaan in face-to-face learning. *COLLASE*

(Creative of Learning Students Elementary Education), 6(1), 19-26.

Lincoln, Yvonna S & Egon G. Guba. (1985). *Naturalistic Inquiry.* California: Sage

Margono. (1997). *Educational Research Methods*. Jakarta: Rineka Cipta.

Murniati, M., Desti, MA, & Sriyanti, I. (2021). Analysis of Science Process Skills (Kps) of Prospective Physics Teacher Students at the Faculty of Teacher Training and Education, Sriwijaya University. *Journal of Innovation and Physics Learning,* 8(2), 208-217.

Nizar, M., Najib, M., Md-ali, R., & Yaacob, A. (2022). Effects of Phet Interactive Simulation Activities on Secondary School Students' Physics Achievement. *South Asian Journal of Social Sciences & Humanities,* 3(2), 73–88.https://doi.org/10.48165/sajssh.2022.32

Nurianto Ramadhani, A., & Herniati SDN Srondol Wetan, U. (2023). Application of Inquiry Learning Model Variation of Social Emotional Learning to Increase English Learning Motivation of Class 2 SDN Srondol Wetan 5 Semarang. *Journal of Education and Social Sciences (JUPENDIS),* 1(4), 29–40.https://doi.org/10.54066/jupendis.v1i3.861

Ouahi, M. Ben, Lamri, D., Hassouni, T., & Al Ibrahmi, E.M. (2022). Science teachers' views on the use and effectiveness of interactive simulations in science teaching and learning. *International Journal of Instruction,* 15(1), 277–292.https://doi.org/10.29333/iji.2022.1511

Parnawi, A., & Alfisyahrin, R. (2023). Application of Inquiry Learning Strategies in Improving Students' Intellectuals in Islamic Religious Education Learning. *Berajah Journal,* 3(1), 191–200.https://doi.org/10.47353/bj.v3i1.204

Pawestri, E., & Zulfiati, HM (2020). Development of Student Worksheets (LKPD) to Accommodate Student Diversity in Thematic Learning for Class II at Muhammadiyah Danunegaran Elementary School. *TRIHAYU: Journal of Elementary School Education,* 6(3).https://doi.org/10.30738/trihayu.v6i3.8151

Prabowo. (2011). *Research Methodology (Science and Science Education).* Surabaya: UNESA University Press

Rustaman, N., Dirdjosoemarto, S., Yudianto, SA, Achmad, Y., Subekti, R., Rochintaniawati, D., & Nurjhani, M. (2005). *Biology Teaching and Learning Strategies.* Malang: Um Press

Senisum, M., Susilo, H., Suwono, H., & Ibrohim. (2022). GIReSiMCo: A Learning Model to Scaffold Students' Science Process Skills and Biology Cognitive Learning Outcomes. *Educ. Sci*, 12(4), 228. https://doi.org/https://doi.org/10.3390/educsci12040228

Sideri, A., & Skoumios, M. (2021). Science Process Skills in the Greek Primary School Science Textbooks. *Science Education International*, 32(3), 231–236.https://doi.org/10.33828/sei.v32.i3.6

Sutrisna, Nana & Gusnidar. (2022). Development of Inquiry-Based Student Books on Science Material for Grade VIII Junior High School Students. *Journal of Research Innovation.* 2(8).

Sylviani, S. (2020). PhET Simulation as a Tool to Assist Elementary School Students in the Teaching and Learning Process of Mathematics Subjects. *Multimedia Education Journal* 2(1), 1-10.

Widodi, B., Darmaji, & Astalini. (2023). Identification of Science Process Skills and Creative Thinking Abilities of Students. *Indonesian Journal of Science Education and Learning,* 13(1), 1 - 8.

Wiratman, A., Widiyanto, B., & Fadli, M. (2021). Analysis of science process skills of elementary madrasah students during the Covid-19 pandemic. *Bidayatuna: Journal of Elementary Madrasah Teacher Education*, 4(2), 185–197. https://doi.org/https://doi.org/10.54471/bidayatuna.v4i2.948

Yalçınkaya-Önder, E., Zorluoğlu, S.L., Timur, B., Timur, S., Güvenç, E., Özergun, I., & Özdemir, M. (2022). Investigation of Science Textbooks in terms of Science Process Skills. *International Journal of Contemporary Educational Research*, 9(2), 432–449. https://doi.org/http://dx.doi.org/10.33200/ijcer.1031338