JPPIPA 8(5) (2022)

Jurnal Penelitian Pendidikan IPA
Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Effect of the Application of PhET-Assisted Ryleac Model on Students' Science Process Skills

Tirtawaty Abdjul[1*], Nancy Katili[1], Septiana Kurniasari[2], Muhammad Yunus[2]

[1] Study Programme of Science Education, Department of Physics, FMIPA, Universitas Negeri Gorontalo, Indonesia.
[2] Study Programme of Physics, Department of Physics, FMIPA, Universitas Negeri Gorontalo, Indonesia.

Received: August 3, 2022
Revised: October 18, 2022
Accepted: November 27, 2022
Published: November 30, 2022

Corresponding Author:
Tirtawaty Abdjul
tirtawaty@ung.ac.id

DOI: 10.29303/jppipa.v8i5.2235

Abstract: This study aims to determine the effect of applying the PhET-assisted Ryleac model of science learning tools on students' science process skills. The research method is a quasi-experimental design with a one-group pretest-posttest research design. The location of this research is at Junior High School, SMP Negeri Tangagah, in class VIII, Bolaang Uki District, Bolaang Mongondow Selatan Regency, in the 2021/2022 Academic Year. The sample in this study were students of class VIII types A and B. The researcher first validated the Ryleac model of science learning tools assisted by PhET by expert validators and obtained the overall results that the learning tools were very valid. The results of this study indicate that applying the Ryleac model of science learning tools assisted by PhET in learning can improve students' science process skills because students' learning activities are excellent during the learning process. Observation of students' science process skills during the learning process showed excellent results. All students' average responses positively responded to PhET-assisted Ryleac learning with an excellent category. The test results for science process skills showed that PhET-assisted Ryleac model learning could improve students' science process skills.

Keywords: Ryleac model; PhET; Science process skills

Introduction

Science process skills are fundamental to development in education because they are essential to building students' scientific attitudes and problem-solving skills. These necessary competencies can shape students' personalities who are creative, critical, innovative, and competitive in competition in the global world society (Marleni et al., 2019).

Based on the results of observations made by researchers at Junior High School, namely SMP Negeri Tangagah, Bolaang Uki District, Bolaang Mongondow Selatan Regency, the involvement of students in learning has not been implemented by teachers in education. The learning process is generally more dominated by the teacher. Classroom learning only transfers knowledge from teacher to student. Students' activities are more listening and taking notes on what the teacher conveys. In addition, teachers rarely do a practicum in learning. This is due to the limitations of available practicum tools, and the equipment is in disrepair. As a result, students' science process skills do not develop because students are not allowed to observe the material being studied directly. Students' science process skills are still not good, such as following skills, formulating hypotheses, formulating problems, and conveying exploration results in front of the class.

Teachers need to implement the learning that can make students active in education and in actual conditions to overcome these problems, such as the Ryleac learning model assisted by PhET simulation. According to (Abdjul et al., 2019), the inquiry learning model can help students understand and master science concepts. The inquiry learning model can also help students think creatively and critically. The benefits of this learning model can improve students' scientific skills and activities and form scientific attitudes in students. The teacher motivates students to be actively involved in finding their answers, connecting one discovery to another in experimental activities, and then comparing what was found with what other students found (Abdjul et al., 2019). PhET simulations can be used

How to Cite:
Abdjul, T., Katili, N., Kurniasari, S. ., & Yunus, M. (2022). The Effect of the Application of PhET-Assisted Ryleac Model on Students' Science Process Skills . *Jurnal Penelitian Pendidikan IPA*, *8*(5), 2216–2223. https://doi.org/10.29303/jppipa.v8i5.2235

so that the explanation of the material is quickly given by the teacher (Arifin et al., 2022). PhET application as a supporting factor for laboratories in improving student's learning experiences and facilitating students to do practical work interactively, control tools and materials, collect data and be used to present various problem-solving activities carried out during the learning process. in the classroom (Tatli et al., 2012; Arifin et al., 2022). PhET simulation is interactive to educate students to have constructivism thinking patterns. Students can combine their prior knowledge with virtual findings from the run simulation. Learning is more interesting because students can learn while playing in the simulation and visualize science concepts as models (Sari et al., 2013). When studying, students who use PhET simulations can be more comfortable, don't get bored quickly, and improve student learning outcomes (Elisa et al., 2017). In line with that, (Khaerunnisak, 2018) also revealed that PhET makes it easier for students in the learning process. With the PhET application, students can do independent or group practicums in problem-solving in the laboratory. They get a fast and accurate response from the computer (Darrah et al., 2014).

According to (Nafrianti et al., 2017), PhET simulation can present and explain abstract things but cannot be observed directly in real life. The PhET simulation provides sufficient time for experimentation because it can change the variables flexibly according to the needs of investigation in learning. According to Finkelstein, et al (Rizaldi et al., 2020), the advantages of using PhET simulation media in the learning process are providing information about complex physics processes or concepts, attracting students' attention, and increasing motivation to learn in the classroom. They can be used independently, offline, in class or at home. This is in line with Basri's opinion (2019), which is that one of the advantages of the PhET simulation is that it has an attractive appearance, which makes students interested in using it. Based on this description, the researchers researched the Effect of the Application of the Phet-Assisted Ryleac Learning Model on Students' Science Process Skills on Vibration and Wave Learning Materials.

Method

The research method used is a quasi-experimental design, experimental research with difficulty controlling all extra variables (Fraenkel, Jack R., Wallen, 2009). This research design is a one-group pretest-posttest design by (Sugiyono, 2015), as shown in Table 1.

Table 1. One-Group Pretest-posttest Design

Class	Pretest	Action	Posttest
Experiment Class	O	X	O
Replication Class	O	X	O

In this study, the science process skills test was given twice before (pretest) and after the treatment was carried out (posttest). The experiment class will provide a pretest to determine the students' prior knowledge. After that, the researcher will provide therapy to the experiment class by applying the PhET-assisted Ryleac model of science learning tools. Then, the experiment class will be given a posttest to obtain the results of students' understanding of the vibration and wave material presented by the teacher using the PhET-assisted Ryleac model of science learning.

The research location is at a Junior High School, SMP Negeri Tangagah, in class VIII, Bolaang Uki District, Bolaang Mongondow Selatan Regency, for the 2021/2022 academic year. The sample in this study were students of class VIII types A and B.

The researcher first validated the science learning device using the PhET-assisted Ryleac model by an expert validator. Then analyze the assessment results of the validation of science learning tools in the form of percentages. The percentage assessment results are grouped according to (Azwar, 2015), as shown in Table 2.

Table 2. Learning Tool Validity Criteria

Average Score	Category
4.00-3.75	Very Valid
3.75-3.00	Valid
3.00-2.25	Quite Valid
2.25-1.50	Less Valid
1.50-0	Very Invalid

An expert validator has validated the syllabus to get a result of 4, meaning that this result is a very valid criterion. Calculating the validation results of the learning implementation plan from the expert validator obtained feasibility with a value of 3.91, which means this result is a very valid criterion. Calculating the feasibility of teaching materials with a value of 3.85 means this is a very valid criterion. The calculation of the feasibility of the student worksheets obtained a value of 3.86, which means that this result is a very valid criterion. The feasibility analysis of the science process skills test received a value of 3.95, which means this result is a very valid criterion.

In looking at the effect of the application of the PhET-assisted Ryleac model of science learning tools, observations were made of student activities during the learning process, observations of student process skills during the learning process, and administering science process skills tests to students. The skill result test data was then analyzed using the N-gain test. The purpose of formulating the N-gain analysis is to investigate the improvement of mathematical concepts of students who have been given treatment. The obtained N-gain value is classified based on the interpretation according to Hake (1999), as shown in Table 3.

Table 3. Gain Index Interpretation

Gain Index (g)	Criteria
g > 0.7	High
0.3 > g > 0.7	Medium
g ≤ 0.3	Low

After being given treatment in the experimental class, which was tested using the PhET-assisted Ryleac model of science learning on vibration and wave learning material, students filled out a response questionnaire to the teaching that had been carried out. The analysis was carried out on the results of the student response questionnaire to find out the level of student satisfaction. The Likert scale is used to analyze the calculation of student responses. The percentage results of the student response questionnaire assessments are included in the criteria according to Azwar (2012), as shown in Table 4.

The criteria in the percentage will be used to measure the level of student satisfaction after being given treatment. If the analysis results show a high level of satisfaction, then the learning tools applied in the experimental class are suitable for continuous use.

Table 4. Student Response Criteria

Persentage Achievement (%)	Criteria
86-100	Excellent
76-85	Good
60-75	Enough
55-59	Less
≤54	Not much

Result and Discussion

In this study, to see the effect of the application of the PhET-assisted Ryleac model of science learning tools on students' process skills, observations were made of student activities during the learning process, observations of students' process skills during the learning process, tests of students' science process skills, and student responses to the applied learning tools.

Student activity data were obtained from observations of student activities during the application of the PhET-assisted Ryleac model of science learning tools in the learning process. The results of the analysis of class A and B learning activities are as follows.

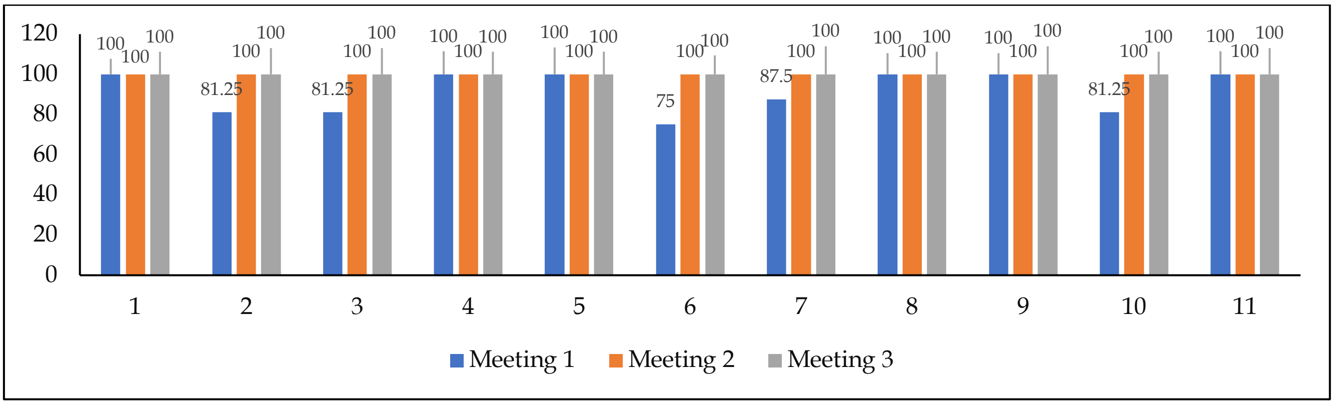

Figure 1. Percentage of student learning activities for class A

Figure 1 shows the first meeting in class A with the lowest percentage of student activity, with a rate of 75% being the 6th activity, which is interpreting the observational data about the vibration of the pendulum. Furthermore, the analysis results of the average activity categories of class A students are the analysis of the average student activity at meetings 1, 2 and 3 reaching 100% of students in the excellent activity category. Furthermore, the learning activities of class B students are as follows in Figure 2.

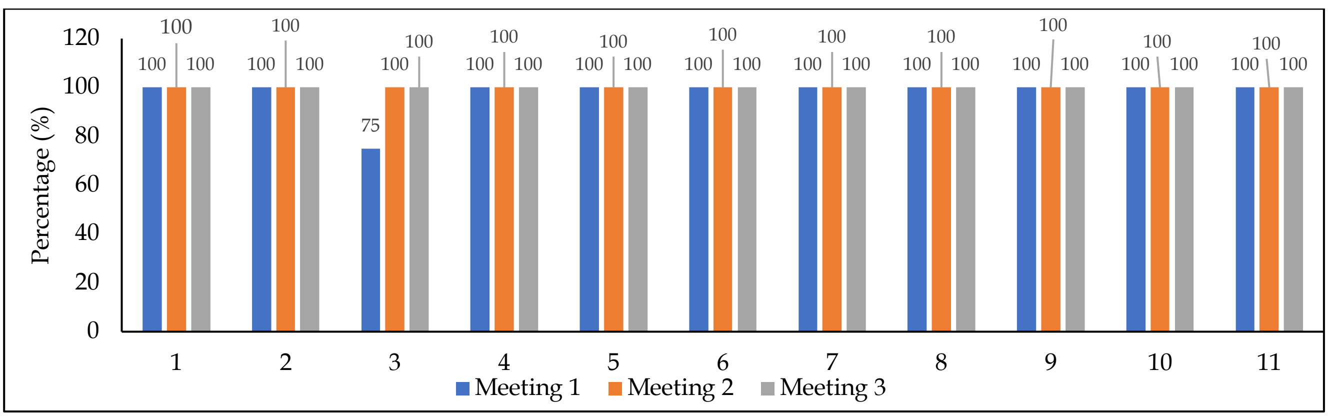

Figure 2. Percentage of Students Learning Activities for Class B

Figure 2 shows the first meeting of class B extended test of the lowest student activity with the lowest percentage of 75%, namely the training of formulating a hypothesis based on the formulation of the problem about the vibration on the pendulum. Furthermore, the analysis results of the average category of student activity in the extended test class B are the analysis of the average student activity at the meeting 1, 2 and 3 meetings, reaching 100% of students in the excellent activity category. Based on the analysis of the activity data of class A and B students, it can conclude that learning using the PhET-assisted Ryleac model learning device can activate students in carrying out science learning, especially vibration and wave learning materials.

The results of observations regarding the science process skills of grade A and B students carried out during the learning process can be seen in Figure 3.

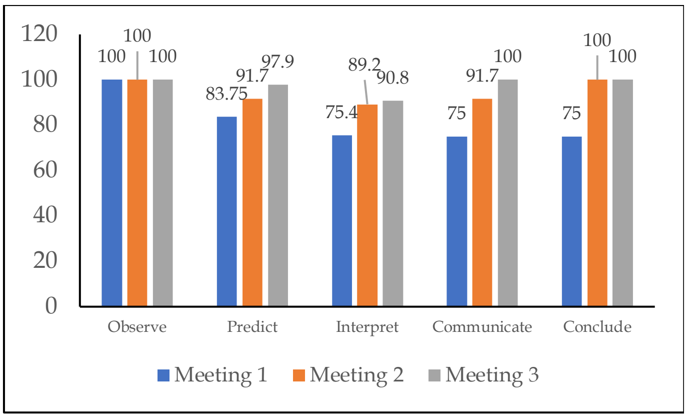

Figure 3. Percentage of observation of science process skills for class A.

Figure 5 shows that every aspect of science process skills has increased from meeting 1 to meeting 3 for each indicator. The lowest aspect percentage of science process skills in class A interprets the data with a ratio of 75.4% at the first meeting, and the observing indicator reaches a ratio of up to 100%. Furthermore, the observation analysis results of the science process skills of class B students can be seen in Figure 4.

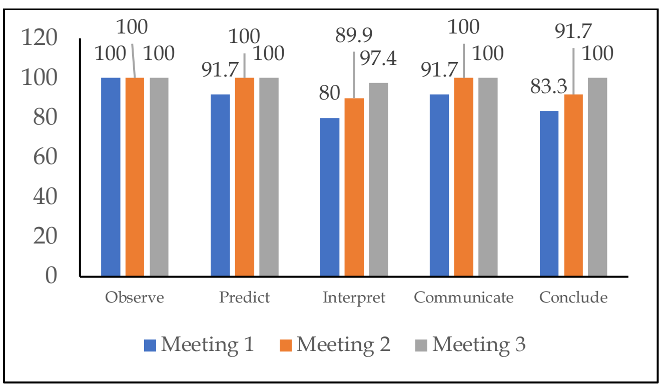

Figure 4. Percentage of observation of science process skills for Class B.

Figure 4 states that the aspects of observing, predicting, interpreting, communicating, and concluding in each meeting have increased with the highest percentage, up to 100%.

Results of Data Analysis of Science Process Skills Test

In applying the Ryleac model of science learning tools assisted by PhET, a science skills test was conducted to measure students' science skills before and after using the Ryleac model of science learning tools assisted by PhET. The average test results of the science process skills of grade A and B students are shown in Figure 5.

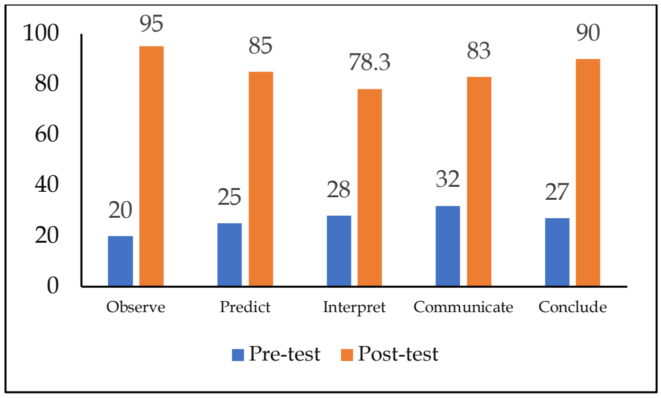

Figure 5. Graph of Process Skills test results for class A.

Figure 5 describes the percentage of aspects observing 95%, predicting 85%, interpreting data 78.3%, communicating 83%, and concluding 90%. The post-test results obtained an average post-test score of 80. Classically, the number of students who took the post-test was 20 students. 20% got a score of <75, meaning that several students had not completed it, and 80% of students completed it. Based on the analysis of the average N-Gain test, the results of the student's science process skills test were 0.71, namely in the high category. Furthermore, the results of the class B science process skills test are described in Figure 6.

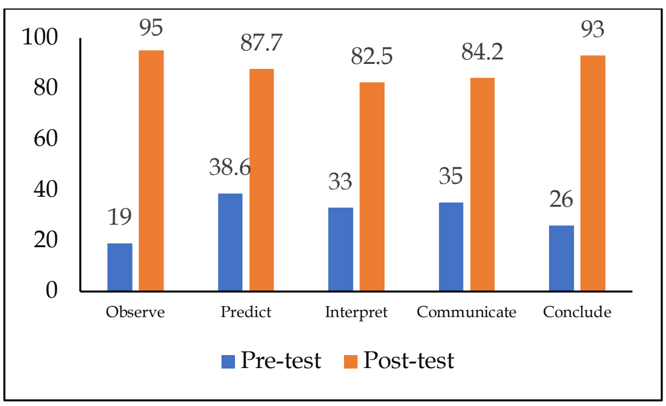

Figure 6. Graph of process science skills test results for class B.

Figure 6 shows the percentage of aspects observing 95%, predicting 87.7%, interpreting data 82.5%, communicating 84.2%, and concluding 93%. Classically, the number of students who took the post-test was 19 students. 21.1% got a score of <75, meaning that several students had not completed and 78.9% of them completed it. The analysis of the average N-Gain test found that the results of the student's science process skills test were 0.65, namely in the medium category. The following are the N-Gain categories for class A and B students show in Figure 7.

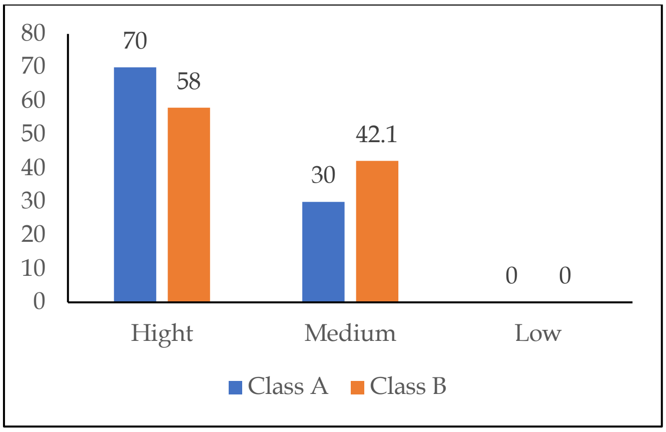

Figure 7. N-Gain category for Class A and B.

The results of the analysis of the average student responses are shown in Figure 8. It shows the response analysis of students who gave the highest positive response reaching 90%, namely in the aspect of "Learning science with the PhET-assisted Ryleac model can explore myself". Furthermore, the reaction of class B students to the PhET-assisted Ryleac model learning can be seen in Figure 9.

Figure 9 is an analysis of the responses of class B students who obtained the highest percentage reaching 81% agreeing on the aspect "The student worksheets used in learning is exciting" and 81% strongly agreeing, "I found a difference with previous learning".

Based on the analysis of class A and class B students' response data, it can conclude that the student's response to the device used with the PhET-assisted Ryleac learning model is excellent.

This experimental study aims to determine the effect of applying the PhET-assisted Ryleac model of science learning tools. The learning tools used in this study include the syllabus, lesson plans, teaching materials, and student worksheets. The researcher first validated using the Ryleac model science learning device assisted by PhET by an expert validator. The instrument validator by the experts obtained four results for the syllabus, meaning that this was in the very valid criteria. Calculating the validation results of the learning implementation plan from the expert validator obtained feasibility with a value of 3.91, which means this result is a very valid criterion. Calculating the feasibility of teaching materials received a value of 3.85 which means this result is a very valid criterion. The calculation of the feasibility of the student worksheets obtained a value of 3.86, which means that this result is a very valid criterion. The validation results concluded that the learning tools used in this study were very feasible.

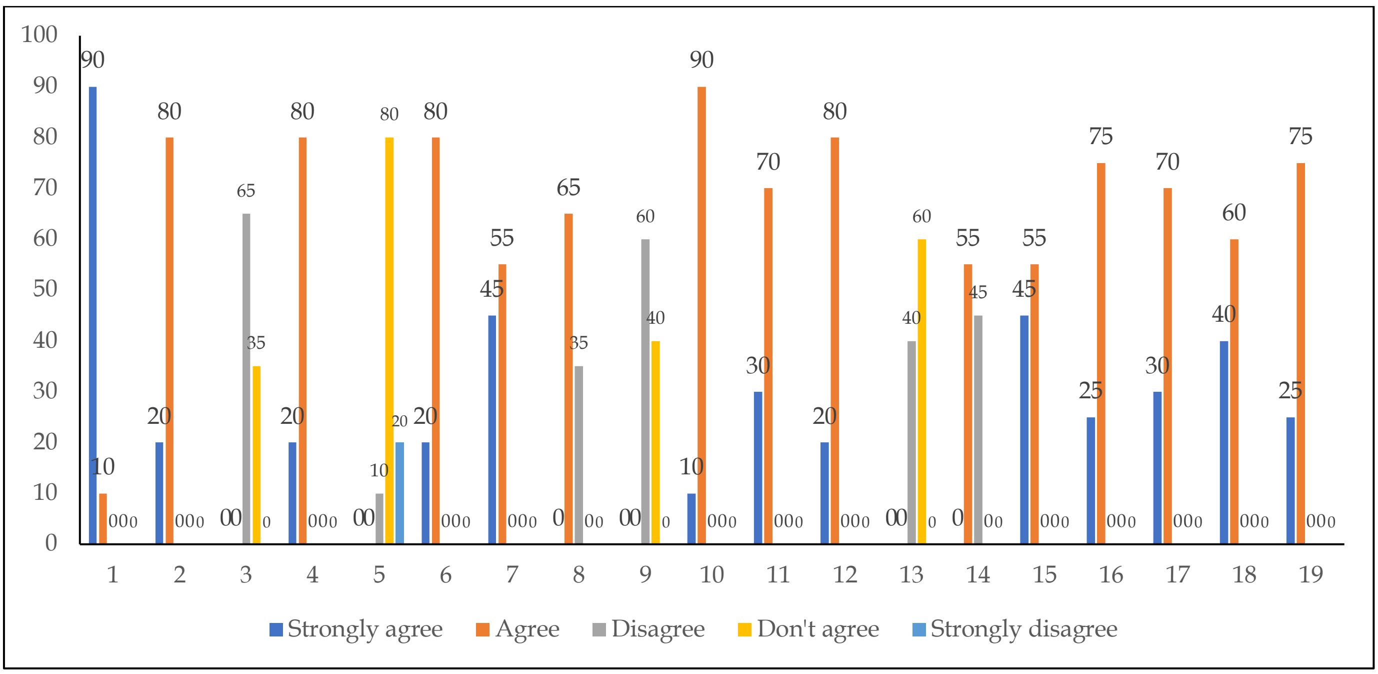

Figure 8. Response of class A students to the application of the PhET-assisted Ryleac learning model

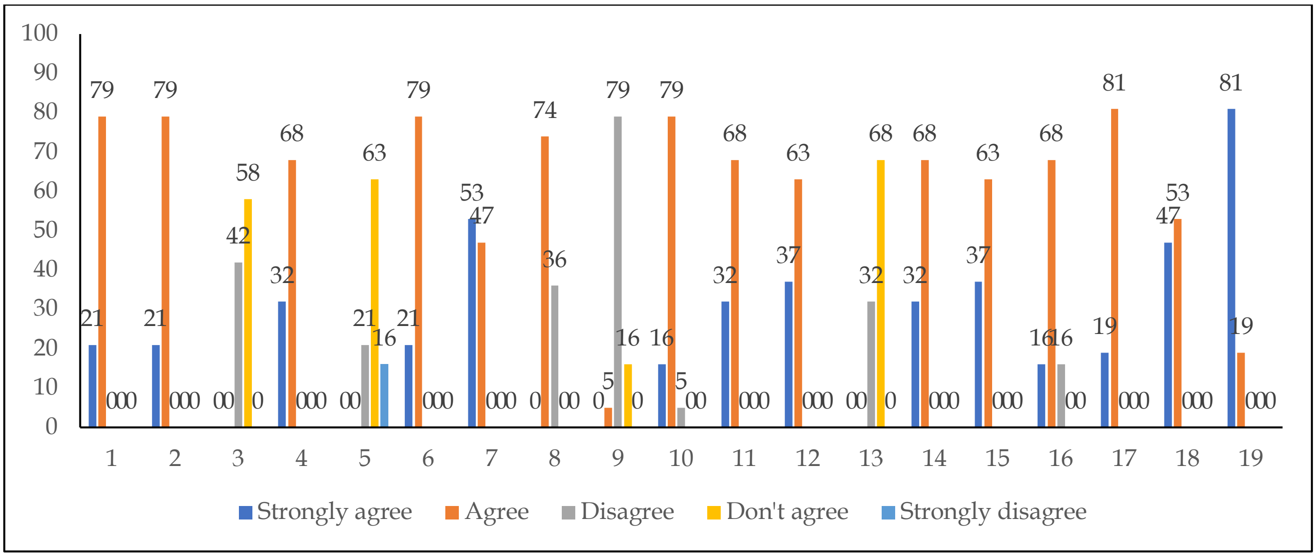

Figure 9. Response of class B students to the application of the PhET-assisted Ryleac learning model.

Based on the previous description, the effect of science learning tools using the PhET-assisted Ryleac model on students' science process skills carried out several activities, namely observing student activities during the learning process, keeping student process skills during the learning process, testing students' science process skills, and applying student responses to learning tools. In observing student activities, 11 indicators are assessed during the learning process, adjusted to the Ryleac syntax. Based on Figure 1 and Figure 3 regarding the percentage of students' learning activities in grades A and B, it can see that at the first meeting, the lowest rate was 75%, namely in the 6th activity, interpreting the observational data about the vibration on the pendulum. In addition, at the first meeting in class A, five indicators did not achieve 100% results. In class B, one indicator did not reach 100% results because learning the Ryleac model using PhET is relatively new. This research study was conducted for three meetings. Students need time to adjust to the learning model and the media used. Student activity reaches 100% at the first, second, and third meetings in classes A and B. The results showed that the average student activity reached 100% in the excellent category. Learning using the Ryleac model learning device assisted by PhET affects student learning activities. So, student activity depends on the teacher's role. That is, every teacher is expected to be able to direct student learning activities to achieve learning success. This statement is the opinion of (Sardiman, 2011), the higher the activeness of the students, the higher the success of the learning process to improve student learning outcomes. This statement focuses on the psychomotor aspect. Students are more active in the learning process, then the acquisition of learning outcomes has a good impact. According to (Wibowo, 2016), learning achievement is determined by the learning process. The more students enjoy learning, the better their accomplishments.

In the Ryleac model learning process, students' science process skills are observed during the learning process. Figure 4.6 shows the lowest percentage of students' science process skills observation of 75.4% in interpreting the observational data. Science process skills in analyzing data have indicators, namely recording and processing observational data. At this stage, the teacher asks students to record the observational data obtained through the exploration stage in the table listed in the student worksheets. Then the students process the observed data, make graphs and interpret the graphs made with the teacher's guidance. This interpretation skill is generally owned by students from activities carried out based on student worksheets. The initial experiment of the meeting explained that some students did not interpret the observed data according to the theory. However, in the observing aspect, the highest percentage was obtained, up to 100%, from the beginning to the third meeting. These results show that using the PhET-assisted Ryleac model learning device affects students' science process skills. Based on the description of the results obtained, it states that the students' science process skills in the learning process using the PhET-assisted Ryleac model learning device are excellent.

This study was given a science process skills test twice, conducted before the learning process (pretest) and after the learning process (posttest). This science process skills test consists of several multiple-choice questions for students to determine the improvement and percentage of students' science process skills. From this science process skills test, class A and class B respectively obtained the average results of the science process skills test regarding the percentage of students' science process skills. Figure 7 and Figure 8 get the highest rate reaching 95% in observing. The lowest percentage for class A is 78.3%, and for class B is 82.5%. Overall, Figure 9 explains the students' science process skills based on the results of N-Gain for class A and class B students' science process skills after learning the PhET-assisted Ryleac model on vibration and wave materials have increased in the high and medium categories. So, it can conclude that PhET-assisted Ryleac model learning can improve students' science process skills. This proves that students have experienced the learning process, based on a statement by Morgan in the book Introduction to Psychology which was later quoted (Ngalim, 2006), that learning is any permanent change in behavior that occurs as a result of practice or experience. According to (Nurhayati et al., 2014), in their research, student learning outcomes on material taught with PhET simulation media were more effective than conventional methods. Differences in student learning outcomes can occur due to using PhET simulation media to use learning methods. Students in the learning process are not only limited to imagining the concepts contained in the vibration and wave material being taught. Still, they can see firsthand the characteristics of the vibration and wave learning material.

After the learning process using the Ryleac model of science learning tools assisted by PhET, students were asked to fill out a response questionnaire to the learning that had been carried out. The results of the response of class A students are shown in Figure 10, with the highest percentage of 90%. They stated that they strongly agreed on aspect 1 (the material for vibrations and waves presented with the PhET-assisted Ryleac model was exciting, so it made me more enthusiastic about learning). Statement of agreement on aspects (Learning science with PhET-assisted Ryleac model can explore me). Figure 11 on the percentage of responses from Class B students shows the highest rate reaching 81% in aspect 17 (the worksheet used during the learning process is exciting) and aspect 19 (I found differences with previous learning). This shows that all average students responded positively to PhET-assisted Ryleac learning with an excellent category. These results can be concluded that applying the Ryleac model of science learning tools assisted by PhET has a good effect on students when viewed from the student's response.

This study proves that the Ryleac model of science learning tools assisted by PhET positively influences students' science process skills, which were previously considered to be poor, such as observing skills, formulating hypotheses, formulating problems, and conveying exploration results in front of the class. This is because applied learning can improve students' science skills, one of the higher-order thinking skills. In line with the results obtained, Wieman and Perkins (2006) stated that using PhET simulation in learning often leads to questions that train students' higher-order thinking skills. For example, linking a concept learned to their own experiences, asking "what if" questions, or extending a class discussion to the application or consequences of the physics concept itself. This is evidenced by research conducted by (Najib, 2015) that using the PhET simulation program in laboratory inquiry learning can improve students' conceptual and higher-order thinking skills. In another study, (Setiadi et al., 2015) stated that science process skills have the potential to be developed using the PhET simulation program, namely observing, interpreting, predicting, and communicating. This is also proven in a study by (Ngadinem, 2019), which concluded that using PhET simulation media in physics learning can improve students' science process skills.

Conclusion

Applying the Ryleac model of science learning tools assisted by PhET in learning can improve students' science process skills. This can be seen from the excellent student learning activities during the learning process. Observation of students' science process skills during the learning process showed excellent results. The average response of all students positively responded to PhET-assisted Ryleac learning with an excellent category. The test results of science process skills show that the PhET-assisted Ryleac model learning can improve students' science process skills.

Acknowledgements

This research was supported by "LP2M Universitas Negeri Gorontalo on the source of funds from PNBP Contract No. B/189/UN47.D1/PT.01.03/2022".

References

Abdjul, T., Mursalin, Nusantari, E., & Pomalato, W. D. S. (2019). The Development of Inquiry By Learning Cycle (Ryleac) Model on Electricity and Magnetic Concept to Increase Science Process Skill and the Academic Achievement of Students. *European Journal of Education Studies*, *6*(4), 414–432. https://oapub.org/edu/index.php/ejes/article/view/2569%0Ahttps://oapub.org/edu/index.php/ejes/article/viewFile/2569/5207

Arifin, M. M., Prastowo, S. B., & Harijanto, A. (2022). Efektivitas Penggunaan Simulasi Phet Dalam Pembelajaran Online Terhadap Hasil Belajar Siswa. *Jurnal Pembelajaran Fisika*, *11*(1), 16. https://doi.org/10.19184/jpf.v11i1.30612

Azwar, S. (2015). *Reliabilitas Dan Validitas, Keempat*. Pustaka Pelajar.

Darrah, M., Humbert, R., Finstein, J., Simon, M., & Hopkins, J. (2014). Are Virtual Labs as Effective as

Hands-on Labs for Undergraduate Physics? A Comparative Study at Two Major Universities. *Journal of Science Education and Technology*, *23*(6), 803–814. https://doi.org/10.1007/s10956-014-9513-9

Elisa, E., Mardiyah, A., & Ariaji, R. (2017). Peningkatan Pemahaman Konsep Fisika dan Aktivitas Mahasiswa Melalui PhET Simulation. *PeTeKa*, *1*(1), 15. https://doi.org/10.31604/ptk.v1i1.15-20

Fraenkel, Jack R., Wallen, N. E. (2009). How to Design and Evaluate Research in Education. In *McGraw-Hill Higher Education* (Issue 0). The McGraw-Hill Companies.

Khaerunnisak, K. (2018). Peningkatan Pemahaman Konsep dan Motivasi Belajar Siswa Melalui Simulasi Physic Education and Technology (PhET). *Jurnal Penelitian Pendidikan IPA*, *4*(2), 7–12. https://doi.org/10.29303/jppipa.v4i2.109

Marleni, A., & Sahono, B. (2019). Application of Inquiry Laboratory Learning Models to Improve Science and Science Process Learning. *Jurnal Ilmiah Teknologi …*, *9*(1), 1–11. https://ejournal.unib.ac.id/index.php/diadik/article/view/17937

Nafrianti, N., Supardi, Z. A. I., & Erman, E. (2017). Pengembangan Perangkat Pembelajaran Inkuiri Terbimbing Berbantuan PhET pada Materi Listrik Dinamis untuk Meningkatkan Keterampilan Berpikir Kritis Siswa. *JPPS (Jurnal Penelitian Pendidikan Sains)*, *6*(1), 1100. https://doi.org/10.26740/jpps.v6n1.p1100-1106

Najib, A. (2015). *Pengaruh Penggunaan Program Simulasi Phet dalam Pembelajaran Inkuiri Laboratorium terhadap Penguasaan Konsep dan Keterampilan Berpikir Tingkat Tinggi*. Skripsi. Program Studi Pendidikan Fisika. Universitas Negersi Semarang. Semarang.

Ngadinem, N. (2019). Penggunaan Media Simulasi PhET untuk Meningkatkan Keterampilan Proses Sains. *Jurnal Ilmiah WUNY*, *1*(1), 61–70. https://doi.org/10.21831/jwuny.v1i1.26850

Ngalim, P. (2006). Ilmu Pendidikan Teoritis dan Praktis. In *Remaja Rosdakarya*. Remaja Karya.

Nurhayati, N., Fadilah, S., & Mutmainah, M. (2014). Penerapan Metode Demonstrasi Berbantu Media Animasi Software PhET Terhadap Hasil Belajar Siswa dalam Materi Listrik Dinamis Kelas X Madrasah Aliyah Negeri 1 Pontianak. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, *4*(2), 1. https://doi.org/10.26740/jpfa.v4n2.p1-7

Rizaldi, D. R., Jufri, A. W., & Jamaluddin, J. (2020). PhET: Simulasi Interaktif dalam Proses Pembelajaran Fisika. *Jurnal Ilmiah Profesi Pendidikan*, *5*(1), 10–14. https://doi.org/10.29303/jipp.v5i1.103

Sardiman. (2011). *Interaksi dan Motivasi Belajar Mengajar*. RajaGafindo Persada.

Sari, D. P., Achmad, L., & Ahmad, Q. (2013). Uji Coba Pembelajaran IPA dengan LKS sebagai Penunjang Media Virtual PhET pada Materi Hukum Archimedes. *Jurnal Pendidikan Sains E-Pensa*, *1*(2), 15–20. https://jurnalmahasiswa.unesa.ac.id/index.php/2/article/view/2505

Setiadi, R., & Muflika, A. A. (2015). Eksplorasi Pemberdayaan Courseware Simulasi PhET untuk Membangun Keterampilan Proses Sains Siswa SMA. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, *17*(2), 258. https://doi.org/10.18269/jpmipa.v17i2.270

Sugiyono. (2015). *Pendekatan Kuantitatif, Kualitatif, dan R& D*. Alfabeta.

Tatli, Z., & Ayas, A. (2012). Virtual chemistry laboratory: Effect of constructivist learning environment. *Turkish Online Journal of Distance Education*, *13*(1), 183–199. https://dergipark.org.tr/en/pub/tojde/issue/16899/176130

Wibowo, N. (2016). Upaya Peningkatan Keaktifan Siswa Melalui Pembelajaran Berdasarkan Gaya Belajar di SMK Negeri 1 Saptosari. *Elinvo (Electronics, Informatics, and Vocational Education)*, *1*(2), 128–139. https://doi.org/10.21831/elinvo.v1i2.10621