Implementation of an Inquiry Model Assisted with PHET and Teaching Aids to Improve Vocational Students' Learning Outcomes in The Sound Waves Concept

Naomi Ernita Mambai [1*], **Triwiyono** [2], **Albert Lumbu**[3]

[1,2,3] Department of Physics Education Universitas Cenderawasih, Papua, Indonesia

ABSTRACT

Physics learning still tends to be conventional and very rarely takes place using practicum media, so students become less enthusiast. This is contrary with students in vocational schools who tend to learn through practice. This study aims to determine the effect of guided inquiry model assisted with PhET media and teaching aids in physics learning outcomes of class X students of SMKN 3 Technology and Engineering Jayapura on the sound waves concept. This study used the pre-experimental method with one group pretest-posttest design, the research sample was selected from two (control and experimental class) of nine classes through a purposive sampling technique with 25 students each group. The study used pretest and posttest essay questions which were validated by experts. The pretest and posttest data were then tested for normality and the results were normal, then N-gain analysis and hypothesis testing α = 5% significance value were performed. The results of the N-gain analysis obtained were 0.70 where the average value of the posttest>pretest ranged from moderate to high for the experimental class while the N-gain was 0.57 where the average posttest>pretest ranged from low to moderate for the experimental of class control. The results of the hypothesis test were found ($t_{count} < t_{table}$) = (0,000 < 0,05) where H_0 was rejected, so that there was an improvement in learning outcomes and there were differences in learning outcomes before and after learning with treatment in experimental class. The success of this treatment can be seen from the enthusiasm of the students who are involved independently in operating the PhET application on computer media and visual aids during learning. This learning pattern can be applied by readers/teachers in researchers but also in the development of teacher learning towards students' understanding of physics concepts.

INTISARI

Pembelajaran fisika masih cenderung konvensional dan jarang menggunakan media praktikum, sehingga siswa menajdi kurang antusias. Hal ini kurang sesuai dengan karakteristik Sekolah Menengah Kejuruan (SMK) yang mengharuskan banyak praktik dalam pembelajaran. Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan model inkuiri terbimbing berbantu media PhET dan alat peraga dalam pembelajaran fisika untuk meningkatkan hasil belajar siswa kelas X SMKN 3 Teknologi dan Rekayasa Jayapura pada konsep gelombang. Penelitian ini menggunakan metode pra eksperimen dengan one group pretest-posttest design, sampel penelitian dipilih dari 2 kelas dari 9 kelas melalui teknik purposive sampling yaitu kelas X TKJ 2 (kelas kontrol) dan kelas X KGSP (kelas eksperimen) beranggota masing-masing 25 siswa. Instrumen tes berupa soal esay untuk pretest dan posttest telah divalidasi oleh ahli instrumen. Data pretest dan posttest dilakukan uji normalitas dan analisis N-gain, serta pengujian hipotesis

.
* Corresponding author:
Naomi Ernita Mambai, Department of Physics Education Universitas Cenderawasih, Papua, Indonesia
✉ naomimambai@gmail.com

dengan signifikansi α = 5%. Hasil analisis N-gain yang diperoleh sebesar 0,70 dengan nilai rata-rata posttest>pretest dari kisaran sedang sampai tinggi untuk kelas eksperimen, sedangkan pada kelas kontrol N-gain sebesar 0,57 dengan nilai rata-rata posttest>pretest dari kisaran rendah sampai sedang. Hasil Uji hipotesis menunjukkan (thitung < ttabel) yaitu (0,000 < 0,05) dimana H0 ditolak, artinya ada peningkatan hasil belajar dan ada perbedaan hasil belajar sebelum dan sesudah pembelajaran dengan perlakuan pada kelas X. Keberhasilan perlakuan ini terlihat dari antusiasme siswa yang terlibat secara mandiri dalam mengoperasikan aplikasi PhET pada media komputer dan alat peraga selama pembelajaran.Pola Pembelajaran ini dapat diterapkan oleh pembaca/guru dalam penelitia tapi juga dalam pengembangan pembelajaran guru terhadap pemahaman kosep fisika siswa.

A. Introduction

Physics science or what is called Physics lesson is a matter of science that studies a lot of natural phenomena or events that occur by looking at the relationship between substances/concepts, energy and forming variables that accompany them in every natural phenomenon, to the products produced [1]. Physics is a scientific family that is very closely related to human daily life, so in learning it really requires understanding rather than memorization. Natural phenomena that occur in evidence also require process and perseverance to be able to obtain a product scientifically [2]. This is in accordance with the nature of physics itself and in line with the demands of educational goals.

There's a stigma often arises that considers physics as an abstract subject and is mathematically difficult. The stigma keeps getting stronger among students when learning physics tends to work on mathematical problems. Besides that, some teachers have claimed for implementing student centered in learning physics, but in fact the class still leads to teacher centered so that it seems conventional coupled with the lack of collaboration in learning media that attracts sense of enthusiasm that comes from the students itself (act initiative and find concepts), as a result students do not understand the concept and have an effect on low learning outcomes. This condition also occurs in class X students at SMKN 3 Technology and Engineering Jayapura. In learning physics, students show less enthusiasm for learning, they tend to listen to the presentation rather than involve themselves. Based on the results of interview observations with three teachers at SMKN 3 Technology and Engineering Jayapura, it was found that the teachers had implemented learning that led to a scientific approach, and also applied the guided inquiry model in learning using simple experiments.

In addition, based on an interview with the students, it was found from their statements that there had indeed been simple demonstrations in physics learning, but very rarely there were experiments with learning media in the form of learning applications or teaching aids. Learning did last a long time but was more dominant in taking notes, doing assignments, and listening to lectures, so that "students" had

difficulty understanding the simple concepts discussed. This gives the impression that student participation is only for attendance fulfillment, which has an impact on a lack of understanding of concepts and physics learning outcomes. Students with average scores ranging from 30-65, resulting in a low outcome. The use of appropriate learning patterns can make students involve themselves and participate actively and gain as much understanding as possible about the object being studied so that they can collaborate and apply this knowledge in their surroundings [3]. The learning patterns in question include the use of approaches, models, methods, learning media.

One of the appropriate use of models in learning physics is the Guided Inquiry model [4]. The guided inquiry model is a student-oriented learning model where the teacher is only a quality control directing students to find relevant concepts individually or in groups in solving a problem to draw a conclusion independently [5]. The guided inquiry model allows students to be creative in acquiring knowledge by discovering it themselves [6]. A teaching model that allows students to move gradually from identifying problems, identifying hypotheses, formulating problems, collecting data, verifying results and generalizing conclusions [7]. Based on some of the opinions of previous researchers show that the guided inquiry model is a discovery learning model that is oriented towards students to be more skilled in real work that is relevant in finding out, understanding and solving scientific problems to find their own learning solutions as new knowledge for them so that they are capable to master the concept of a theory discussed while the teacher acted as a guide and controller of the process of students finding the exact answer. In addition to models, the use of media in physics learning will greatly assist students in accepting and easily understanding a concept [8]. Learning media is any kind of thing that is used to stimulate students' thoughts, feelings, attention, and willingness to learn from within themselves [9]. The use of media in the learning process can help students gain simple understanding, facilitate the interpretation of data, and condense the information [10].

Physics Education Technology (PhET) is a virtual laboratory-based learning media designed by the University of Colorado, useful as a learning simulation medium [11]. According to Abdjul and Ntobou [12] PhET is a series of laboratory tools in the form of interactive multimedia-based computer software. The PHET media operates simulation activities in the laboratory as if it brings the user to a real laboratory [8]. Learning using PhET simulations is also able to motivate students because it increases the enthusiasm and activity of students, can complete learning outcomes, and students' psychomotor [13]. According to Saregar [14] PhET makes student learning outcomes better. Apart from PhET, the same benefits apply to learning aids. Teaching aids are learning media that contain or carry concepts from the concepts being studied [15]. According to Mujahid and Kurniawan [16] visual aids are media/learning aids and all kinds of objects used to demonstrate learning concepts. Students are very enthusiastic when conducting experiments using teaching aids, there is interaction with fellow members of friends to learn further concepts [17]. Visual aids make it easier for

students to understand the concepts in the concept so that they can improve student learning outcomes [18]. The use of PhET media and teaching aids serves to show or introduce reasons for the occurrence of a problem and the solution to the problem to students. The existence of PhET media and visual aids in wave and sound learning which is implemented using the guided inquiry model makes it easier for the students themselves to actively think and act to find information independently.

Based on the background, the researcher tried to applying the guided inquiry model through PhET virtual laboratories and real simple experiments aids in the wave and sound materials to improve vocational students' learning outcomes. The purpose of this study is to see whether there is an increase in student learning outcomes. The null hypothesis (H0) in the study is that there is no effect of using PHET media and physics teaching aids on student learning outcomes of SMKN 3 Technology and Engineering Jayapura.

B. Method

The research was carried out pre-experimentally with a one-group pretest-posttest design [19]. The research design describe as follows.

$$O_1 \quad \times \quad O_2$$

Figure 1. One-Group Pretest Posttest Design
(Source: Sugiyono, 2015)

Descriptions:
$\times$: Treatment to the experimental group
O_1 : Pretest, test before the material has been given
O_2 : Posttest, test after the material has been given

The population in this study were class X students of SMKN 3 Technology and Engineering Jayapura which were divided into 9 classes. Of the 9 classes, 2 classes were taken as research samples based on learning speed and the number of sample members, namely Class X TKJ 2 (Control class) and X KGSP (Experimental class). Ways in determining the sample class was carried out using a non-probability sampling technique by purposive sampling [19].

The research instrument was a written test using 10 cognitive description questions to measure learning outcomes. Instrument feasibility tests are determined by personal experts (the experts were lecturers and practitioners). The research data were calculated using N-gain statistics using Microsoft Excel software and statistical analysis of prerequisite tests using the normality test *(Nonparametric test-1 sample K-S)*. The result showed that the data were normal. Then for the hypothesis testing, this study used different tests by paired sample T-test technique [20] which was calculated using software SPSS 16 for windows.

C. Results and Discussion

Descriptions of learning outcomes data are presented in the following figure 1:

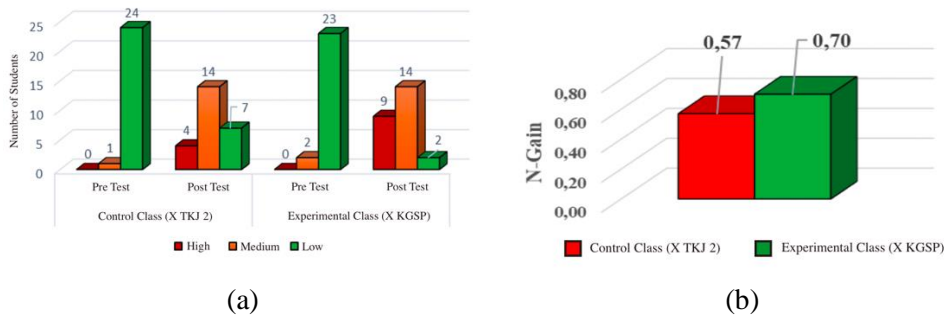(a)   (b)

Figure 1. (a) Diagram of Improved Pretest and Posttest Results of the Concept of Waves and Sound; (b) Diagram of The Average N-gain Chart of All Waves and Sound Concepts,

Figure 1(a) shows that there was no student in the control or experimental class who got a high score, while the posttest scores of students show that students in the experimental class achieve a higher score than the control class (nine points compared to four points). 14 students in the experimental class reached the average score, and 12 students got low posttest scores. In the control class, seven students achieved an average score, while four students got a low posttest score. Figure 1(b), the learning outcomes of all sound wave concepts are seen based on the N-gain value, so that for the control class it is 0,57 in the medium category, for the experiment it is 0,70 in the high category. Figure 1 has proven that there is an improvement in learning outcomes from students in the control class and the experimental class.

The analysis continued with the prerequisite test analysis using normality test and the different test to find out whether there were differences in student learning outcomes as shown in table 1. The prerequisite test obtained the results that the data were normally distributed so that it was continued with a different test (t-test).

Table 1. Different Test Results from Pretest and Posttest Learning Outcomes of All Concepts.

Variable	Class	Class	Normality Test		Different Test	
			Sig.	Desc.	Sig.	Desc.
Learning Outcomes All Concept	Control	Pretest	0,517	Normal	0,000	There's differences
		Posttest	0,222	Normal		
	Experiment	Pretest	0,403	Normal	0,000	There's differences
		Posttest	0,212	Normal		

In hypothesis test, "There is no increase in learning outcomes, testing the null hypothesis using a different test. From the results of statistical tests performed, it was obtained sig t_{count} < significance level $\alpha/2 = 0.05$, namely $0,000 < 0,05$ which means H_0 is rejected, then there are differences in learning outcomes before and after treatment, where the average posttest > pretest is dominant in the moderate category.

The research results showed that there was an improvement in student learning outcomes and there were significant differences in student learning outcomes before and after sound wave learning using the guided inquiry model assisted by PhET media and teaching aids. This is evidenced from the acquisition of hypothesis testing with a significance value less than 0,05 (0,00 < 0,05). The posttest scores of students show that students in the experimental class achieve a higher score than the control class (nine points compared to four points) (see Figure 1(a)). The differences in learning outcomes is also shown in the N-Gain result of the overall concept between the two classes is 0,57 for the moderate category of the control class and 0,70 for the moderate category of the experimental class. The difference in N-Gain between the two classes is 0,13 which means there are differences in learning outcomes between classes X TKJ 2 and X KGSP.

This situation for the researcher has presented that the implementation of the guided inquiry model assisted by PhET media and teaching aids has changed the improvement of learning outcomes for students.

Learning that takes place using the guided inquiry model assisted by PhET media in this study helps students find concepts that are abstract to the average eyesight, while the use of guided inquiry models assisted by teaching aids represents learning material that is tangible and can be developed independently so that it can be better understood by students. Based on the study, the application of the guided inquiry model assisted by PhET media and teaching aids can improve the learning outcomes of class X students of SMKN 3 Engineering Technology Jayapura on the concept of sound waves which is evident from the results of learning outcomes for all sound wave concepts of experimental class students from an N-gain value of 0,70 category to high while students in the N-gain control class were 0,57 in the medium category.

These results are consistent with Sukma's research that the guided inquiry learning model makes a positive contribution to student learning outcomes. The implementation of physics learning using the guided inquiry model can improve student learning outcomes in the concepts of vibration, waves, and sound [4]. The application of simulation media using PhET can improve physics learning outcomes in the medium category in class X students [8]. Maretasari et al. [21] showed that research obtained a learning gain of 0,53 proving that the laboratory-based guided inquiry model has a significant positive effect on learning outcomes and students' scientific attitudes.

Previous research by Purwanto et al. [22] found that there were differences in student learning outcomes in learning using PhET media and Teaching Aids. Besides, Ernita et al. [23] explained that there were significant differences in the cognitive physics learning outcomes of students who used real and virtual laboratory-based guided inquiry learning models at a significant level of 5% besides that there were differences in learning outcomes of students who studied using virtual learning media

.

Mambai N E, et al., / Implementation of an Inquiry Model Assisted with PHET and Teaching Aids to Improve Vocational Students' Learning Outcomes in The Sound Waves Concept | 102

PhET-based laboratory (0,70) with results using simple teaching aids (49,56) through the guided inquiry learning model [12].

Learning with guided inquiry is reinforced by the results of Simbolon [24], which showed that there was a significant difference between the gains in physics learning outcomes taught using guided inquiry learning models based on real experiments and virtual laboratories compared to students taught using direct learning models. The results showed that there was an improvement in student learning outcomes with a presentation of 72% in the high category [24] The research results were also obtained by Maretasari et al., [21]that there was an increase in learning gain of 0,53 which was categorized as high from learning that applied the laboratory-based guided inquiry model which had a significant positive effect on learning outcomes.

D. Conclusion

The Guided Inquiry Model is better at increasing the gain in Physics learning outcomes. Based on the finding in this study, collaborative learning treatments using guided inquiry model can help students gradually bring up skills from themselves and independently through group discussions properly, and make students able to remember the concepts in a short time. It was proven in the study that students made conclusions and evaluated learning. Students were able to convey their understanding using their words whose meanings were appropriate with the physics concepts. However, behind the advantages of this media and model it also has disadvantages, namely the use of PHET media on computers and teaching aids which are limited to be used by each student. Therefore, it takes quite a long time to provide opportunities for students to try experimenting.

Acknowledgments

Bibliography

[1] Subekti Y., Ariswan A, "Learning Physics with Experimental Methods to Improve Cognitive Learning Outcomes and Science Process Skills *(Pembelajaran Fisika dengan Metode Eksperimen untuk Meningkatkan Hasil Belajar Kognitif dan Keterampilan Proses Sains)*", Jurnal Inovasi Pendidikan IPA, vol.2(2), pp.252 – 261, 2016.

[2] P. Kurnianto., P. Dwijayanti., & Khumaedi, "Development of Ability to Summarize and Communicate Physics Concepts Through Simple Physics Practicum Activities *(Pengembangan Kemampuan Menyimpulkan Dan Mengkomunikasikan Konsep Fisika Melalui Kegiatan Praktikum Fisika Sederhana)*", Jurnal Pendidikan Fisika Indonesia, vol.6 (1), pp.6-9, 2010.

[3] Rafidah, U., Kasli, E., & Susana, "Application of the Inquiry Learning Method with Virtual Laboratory Media (PhET) to Improve Student Learning Outcomes on the Concept of Harmonic *Vibration (Penerapan Metode Pembelajaran Inkuiri Dengan Media Laboratorium Virtual (PhET) Untuk Meningkatkan Hasil Belajar Siswa Pada Konsep Getaran Harmonis)*", Jurnal Ilmiah Pendidikan Fisika, vol.2(2), pp.226, 2017.

[4] Hapsari, A. D., Handdhika, J., & Huriawan, F., "Implementation of Guided Inquiry on Vibration, Wave and Sound Learning on Increasing Cognitive Learning Outcomes *(Implementasi Inkuiri Terbimbing pada Pembelajaran Getaran, Gelombang dan Bunyi Terhadap Peningkatan Hasil Belajar Kognitif)*", Jurnal Prosiding Seminar Nasional Fisika dan Aplikasinya*, Prosiding SNFA,* 1(1), 285-287, 2017.

[5] Ayuningtias, P., Soegiming, W. W., dan Supardi, A. I., "Development of Physics Learning Devices Using Guided Inquiry Models to Train High School Students' Science Process Skills on the Concept of Static Fluids *(Pengembangan Perangkat Pembelajaran Fisika Dengan Model Inkuiri Terbimbing Untuk Melatih Ketrampilan Proses Sains Siswa SMA Pada Konsep Fluida Statis)*, Jurnal Sains Pascasarjana Universitas Negeri Surabaya*,* vol.4(2), pp.636-645, 2015.

[6] Wahyudi, L. E., & Supardi, Z. A. I., "Application of the Guided Inquiry Model on the Subject of Heat to Train Science Process Skills on Learning Outcomes at SMAN 1 Sumenep *(Penerapan Model Inkuiri Terbimbing Pada Pokok Bahasan Kalor Untuk Melatih Ketrampilan Proses Sain Terhadap Hasil Belajar di SMAN 1 Sumenep)*", Jurnal Inovasi Pendidikan Fisika*,* vol.2(2), pp.62-65, 2013.

[7] Matthew, M.B., & Kenneth, I. O., "A Study On the Effect Og Guided Inqury Teaching Method On Students Achievement in Logic", The International Research Journal*,* 2(1), 133-140, 2013.

[8] Ekawati, Y., Haris, A., & Amin, B.D., "Application of Simulation Media Using PHET on Physics Learning Outcomes of Class X SMA Muhammadiyah Limbung *(Penerapan Media Simulasi Menggunakan PHET Terhadap Hasil Belajar Fisika Siswa Kelas X SMA Muhammadiyah Limbung)*", Physics Education and Technology, vol.1(3), pp.75-81, 2015.

[9] Uliyandari, M., & Lubis, E.E., "Application of the Guided Inquiry Learning Model with Volcano Teaching Aids in Science Subjects at SDN 013 North Bengkulu *(Penerapan Model Pembelajaran Inkuiri Terbimbing dengan Media Alat Peraga Gunung Berapi Pada Mata Pelajaran IPA SDN 013 Bengkulu Utara)*", Journal of Science Education, vol.4(2), pp.74-78, 2020.

[10] Dwipangestu, R., Mayub, A., & Rohadi N, "Development of Video-Based High School Physics Learning Media Design on the Concept of Sound Waves *(Pengembangan Desain Media Pembelajaran Fisika SMA Berbasis Video Pada Konsep Gelombang Bunyi)*", Jurnal Kumparan Fisika, vol.1(1), pp.48-55, 2018.

[11] Slamet, I.B., Lumbu, A., "The Use of Phet Simulation On Physics Chapter Wave and Vibratio in 3t Region", Jurnal Penelitian dan Pengapdian Kepada Masyarakat UNSIQ, vol. 8(3), pp.328-337, 2021.

[12] Abdjul, T., & Ntobou, N. E., "Application of PhET-Based Virtual Laboratory Learning Media to Student Learning Outcomes in the Wave Concept *(Penerapan Media Pembelajaran Virtual Laboratory Berbasis PhET terhadap Hasil Belajar Siswa pada Konsep Gelombang)*", Jurnal Pendidikan Fisika Taudulako, 7(3), 26-31, 2019.

[13] Prihatiningtyas, S., Prastowo, T., & Jatmiko, B., "Imlementasi Simulasi Virtual Laboratorium dan Kit Sederhana untuk Mengajarkan Keterampilan Psikomotor Siswa pada Pokok Bahasan Alat Optik *(Implementation of Virtual Laboratory Simulations and Simple Kits to Teach Students Psychomotor Skills on the Subject of Optical Instruments)*", Jurnal Pendidikan IPA Indonesia, vol.2(1), pp.18-22, 2013.

[14] Saregar, A., "Learning Introductory Quantum Physics Using PhET Simulation Media and LKM Through a Scientific Approach: The Impact on Students' Interest and Mastery of Concepts *(Pembelajaran Pengantar Fisika Kuantum Dengan Memanfaatkan Media PhET Simulation Dan LKM Melalui Pendekatan Saintifik: Dampak pada Minat dan Penguasaan Konsep Mahasiswa)*", Jurnal Ilmiah Pendidikan Fisika, vol.5(1), pp.53-60, 2016.

[15] Wicaksoni, H. T., Kurniawan, E.S., & Maftukhin, H., "Development of Resonator Teaching Aids as Alternative Learning Media on the Concept of Sound Waves for Class XII SMA *(Pengembangan Alat Peraga Resonator sebagai Alternatif Media Pembelajaran pada Konsep Gelombang Bunyi Kelas XII SMA)*", Jurnal Berkala Pendidikan Fisika, vol.3(2), pp.142-144, 20113.

[16] Mujahid, M., & Kurniawan, A., "Development of Learning Media in the Car Starter System to improve student learning outcomes at Cipta Karya Prembun Vocational School *(Pengembengan Media Pembelajaran Pada System Stater Mobil untuk meningkatkan hasil belajar siswa di SMK Cipta Karya Prembun)*", Jurnal Pendidikan teknik Otomotif, vol.1(5), pp.15-20, 2015.

[17] Haqqo, A., Prabowo, "Development of Ripple Tank Teaching Aids as Physics Learning Media on the Concept of Mechanical Waves to Improve Student Learning Outcomes *(Pengembangan Alat Peraga Ripple Tank Sebagai Media Pembelajaran Fisika Pada Konsep Gelombang Mekanik Untuk Meningkatkan Hasil Belajar Peserta Didik)*", Jurnal Pendidikan Fisika, vol.2(7), pp.341- 346, 2018.

[18] Haisy, M. C., Astra, I. M., & Handoko, E. N., "Development of Pc/Laptop Soundcard-Based Resonance and Doppler Effect Teaching Aids to Increase High School Students' Physics Learning Motivation *(Pengembangan Alat Peraga Resonansi Dan Efek Doppler Berbasis Soundcard Pc/Laptop Untuk*

Meningkatkan Motivasi Belajar Fisika Siswa SMA)", Prosiding Seminar Nasional Fisika (E-Journal), vol.5(2), pp.87-89, 2015.

[19] Sugiyono, Quantitative Qualitative Research Methods And R and D *(Metode Penelitian Kuantitatif Kualitatif Dan R dan D).* Bandung: Alfabeta, 2015.

[20] Siregar, S, Quantitative Research Methods (*Metode Penelitian Kuantitatif).* Jakarta: Kencana, 2015.

[21] Maretasari, E., Subali, B., & Hartono, "Application of the Laboratory-Based Guided Inquiry Learning Model to Improve Student Learning Outcomes and Scientific Attitudes *(Penerapan Model Pembelajaran Inkuiri Terbimbing Berbasis Laboratorium Untuk Meningkatkan Hasil Belajar Dan Sikap Ilmiah Siswa)*", Unnes Physics Education Journal, vol.1(1), pp.27-29, 2013.

[22] Purwanto A.E., Susanti N., & Hendri M., "Comparative Study of Student Learning Outcomes Using PhET Simulations Media with Teaching Aids on the Subject of Magnetic Electricity in Class IX of SMPN 12 Tebo District *(Studi Perbandingan Hasil Belajar Siswa Menggunakan Media PhET Simulations dengan Alat Peraga Pada Pokok Bahasan Listrik Maknet Di Kelas IX SMPN 12 Kabupaten Tebo)*", Jurnal Pendidikan Fisika, vol.1(1), pp.10-16, 2016.

[23] Ernita, N., Harjono, A., & Sridan, N., "Application of the Laboratory-Based Guided Inquiry Learning Model and Its Influence on Student Physics Learning Outcomes at SMA Negeri 8 Mataram *(Penerapan Model Pembelajaran Inkuiri Terbimbing Berbasis Laboratorium Dan Pengaruhnya Terhadap Hasil Belajar Fisika Siswa SMA Negeri 8 Mataram)*", Jurnal Ilmiah Pendidikan Fisika, vol.1(2), pp.103-107, 2018.

[24] Simbolon, D. H., "The Influence of Real Experiment-Based Guided Inquiry Learning Model and Virtual Laboratory on Student Physics Learning Outcomes *(Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Eksperimen Riil dan Laboratorium Virtual Terhadap Hasil Belajar Fisika Siswa)*", Jurnal Pendidikan, vol.21(3), pp.299-315, 2015.

.

Mambai N E, et al., / Implementation of an Inquiry Model Assisted with PHET and Teaching Aids to Improve Vocational Students' Learning Outcomes in The Sound Waves Concept | 106