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Feasibility of Learning Devices with Guided Inquiry Model to Develop Senior High School Students' Science Process Skills

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ABSTRACT

This research aims to produce learning devices with guided inquiry models that are valid, practical, and effective, making them worth using to practice students' science process skills. This development research uses the ADDIE model. Developed the device in a trial to grade XI students at one of the State High Schools in Banjarmasin. Data collection uses learning device validation sheet instruments, lesson plan implementation, observation sheets, and learning outcome tests. The results showed that the learning tools developed: (1) valid based on the assessments of academics and practitioners, (2) practical based on the implementation of the lesson plan, and (3) effective with medium categories based on N-gain results of learning outcomes. Concluded that learning devices with guided inquiry models deserve to be used to practice students' science process skills. This learning device can be one of the alternatives, especially in temperature and heat materials at the High School level.

INTRODUCTION

Education aims to develop students' knowledge, potential, and skills (Ghafar, 2020; Ihsan et al., 2017; Ramberg et al., 2021). Students are expected to actively develop their abilities independently in the physics learning process, especially in developing science prose skills (SPS) (Arifuddin et al., 2020; Hidayat et al., 2016; Wang et al., 2015). The physics learning process emphasizes SPS, involving cognitive, social, and communication skills. Therefore, science process skills in physics learning need to be developed to instill a scientific attitude in students (Khaerunnisa, 2017; Limatahu & Mubarok, 2020; Misbah et al., 2018). SPS is a provision to apply the scientific method in finding a concept and facts learned (Ekici & Erdem, 2020; Elnada, 2016; Inayah et al., 2020).

The facts in the field, especially in some schools such as Banjarmasin, show that in physics learning, teachers more often use learning methods and models of learning that are still focused on teachers, so SPS students are less trained (Alkan, 2016; Ansari et al., 2017; Hernawati et al., 2018). Similar facts are also obtained based on data from the researchers' preliminary studies to find out the SPS that students have. The subject of the preliminary research is an X-grader student at one of the State High Schools in Banjarmasin city; obtained that 58.33% of students have not been able to formulate hypotheses, 83.33% of students have not been able to identify variables, 50% of students have not been able to conduct experiments, 91.67% of students have not been able to analyze data, and 95.83% students have not been able to conclude data. This is due to several factors, including, (1) the physics learning process has so far only used a direct teaching model with lecture and demonstration methods, (2) the intensity of teachers in carrying out practicum is minimal, and (3) teachers only use printed books from publishers provided by schools, (4) learning devices used by teachers are also not optimal, for example still using lesson plan implementation which is commonly used for all schools, (5) The contents of the high school printed book used are also not following the needs of students, (6) The depth and clarity of teaching materials contained in the printed book are still not very clear, and there are still many that are not following the syllabus.

Alternatives are used to achieve learning goals, and several ways are needed, namely by developing a learning device. Learning devices are a set of media or means that can help and facilitate learners in the teaching and learning process to achieve predetermined goals (Ayuningtyas et al., 2015; Nusantari et al., 2021; Zainuddin & Misbah, 2021). Learning tools are needed to support the teaching and learning process in lesson plan implementation, teaching materials, student worksheets, and learning outcome tests. Therefore, researchers developed learning devices using guided inquiry models to train students' SPS. The role of the teacher in the guided inquiry learning model is quite dominant, the teacher guides the student in conducting investigations through initial questions, then deploys students to discuss (Agustina et al., 2017; Mills et al., 2014; Pamenang et al., 2020). Students are stimulated to participate actively and be directly involved in the learning process to improve students' ability to understand the material learned. In addition, train students' abilities in science process skills and be able to obtain information independently, practice behaving honestly, disciplined, responsible, cooperate and communicate well (Hidayat et al., 2016; Maknun, 2020; Ural, 2016).

The inquiry learning model involves all students' ability to the maximum to seek and investigate systematically, critically, logically, and analytically so that students can formulate their findings (Ballesta-Claver et al., 2021; Handayani et al., 2017). Through guided inquiry learning, it can teach students to have individual responsibilities and responsibilities in groups (Almuntasheri & Wright, 2016; Ambarsari & Santosa, 2013; Koksal & Berberoglu, 2014). This is in line with several studies conducted by those showing that students' science process skills improve after applied learning with a guided inquiry model (e.g., Karim et al., 2016; Komariah et al., 2017; Nnorom, 2016; Pratono et al., 2018; Sabahiyah & Marhaeni, 2013; Subekti & Ariswan, 2016). The research developed a learning device with guided inquiry models on temperature and heat materials to practice students' science process skills. Therefore, the general purpose of this study is to produce a physics learning device with a guided inquiry model on temperature and heat matter that is feasible to practice students' science process skills.

RESEARCH METHOD

The model used in this research and development is the ADDIE model. The ADDIE model (Analysis, Design, Development or Production, Implementation or Delivery, and Evaluation) was developed by Dick and Carry (1996) to design a learning system that can be used for various forms of product development, one of which is a learning device. Peterson (2003) Explains that there are five stages of ADDIE, consisting of frameworks with different goals and functions in the development process. The five stages of the ADDIE development model are (1) Analysis, in this phase, researchers identify the cause of the learning problem. (2) Design, this design phase uses the output results of the analysis phase that has been done to design strategies for developing learning devices. (3) Development or Production, This development phase aims to produce the necessary learning tools in the learning process. (4) Implementation or Delivery, this implementation phase is the phase of implementing learning tools that have been created to determine the feasibility of learning devices, and (5) Evaluation, in this evaluation phase, researchers determine the feasibility of the learning device developed based on the validity, practicality, and effectiveness and achievement of student SPS, then re-repair the learning device developed if needed.

Participants

The test subjects in this study were in the grade XI students of one of Banjarmasin State High Schools for the 2019/2020 school year, with 22 students. Purposive sampling used to get the participants.

Research Instruments

The research instruments used include: (1) the validity of the learning device reviewed from the learning device validation sheet assessed by three validators, namely two academics and one physics learning practitioner; (2) the practicality of the learning device is reviewed from the observation sheet on the implementation of lesson plan assessed by two observers; and (3) the effectiveness of the learning device is reviewed using student learning outcome test sheets to measure students' cognitive learning outcomes. The validity of learning devices is obtained based on the average score for each aspect of the learning device assessment and is assessed by three validators. The valid category of learning devices is determined by comparing the scores of the assessment results obtained with the validity criteria of the learning device (Widoyoko, 2016). If tested valid, the following data is calculated reliability, and the results of the reliability calculation are then adjusted to the assessment criteria by Arikunto (2013).

The assessment of the observation sheet for the implementation of the lesson plan is calculated by the average value of the total score of each component and adjusted to the criteria for assessing the performance of the lesson plan (Widoyoko, 2016). If tested practically, the following data is calculated reliability as a score equalization involving two observers using the coefficient of agreement formula H. J. X Fernandes and the results of reliability calculations are then adjusted to the assessment criteria by Arikunto (2014). The effectiveness of learning devices can be measured based on the improvement of the student's learning outcome test results in the form of pre-tests and post-tests given at the beginning and end of the learning process. According to Hake (1998), the magnitude of the increase is calculated using the normalized gain (N-gain).

RESULTS AND DISCUSSION

The Validity of Learning Devices

This research developed a learning device with a guided inquiry model to train students' SPS. the products produced in this development research are learning tools in the form of lesson plan implementation, teaching materials, student worksheets, and learning outcome tests. Lesson plan implementation refers to core competencies and basic competencies, then elaborated into indicators of competency achievement and learning goals compiled based on the revised 2013 curriculum. The teaching materials developed are tailored to the content of the material with the needs of students for the high school level and following the school syllabus. The content of the teaching material itself is collected from several literary sources. The teaching material developed consists of front cover, foreword, concept map, keywords, teaching material information, indicators of primary competencies achievement (as a learning goal), temperature and heat learning materials, examples of questions at each meeting, science figures, training questions at each meeting, a summary of materials at each meeting, and bibliography. Student worksheets developed are adapted to the learning model used, namely the guided inquiry model. The guided inquiry model is applied to students to conduct experiments independently but still under the guidance of teachers, both through the instructions for filling in student worksheets and direct assistance by teachers during the teaching and learning process. Learning outcome tests in the form of essay questions refer to the purpose of learning to determine students' cognitive abilities. Learning outcome tests contain as many as ten questions adjusted to the number of learning goals based on the predetermined basic competencies.

The Validity of Learning Devices

The lesson plan implementation validity test consists of several aspects of assessment. The results of the lesson plan implementation validity test calculation are in Table 1. The validity of lesson plan implementation results in Table 1 show that the formulation aspect of learning goals has a very valid category; language aspects have valid categories; aspects of the contents of lesson plan implementation have valid categories, and the time aspect has valid categories. The average result of all aspects obtains a valid category. This valid category of validity illustrates that the lesson plan implementation developed has met the standard of suitable lesson plan implementation components. The assessment by the three validators of this lesson plan implementation has a high level of confidence. Thus, the lesson plan implementation developed deserves to be used in learning to train SPS students.

Table 1. Results of the validity of lesson plan implementation.

Assessment Aspects	Validity	
	Average Score	Category
Formulation of The Framework	3.53	Very Valid
Language	3.25	Valid
Content lesson plan implementation	3.33	Valid
Time	3.17	Valid
Validity	3.32	Valid
Reliability	0.90	Very Highly

The validity test of teaching materials consists of several aspects of assessment, namely characteristics of content feasibility, the feasibility of presentation, language feasibility, and feasibility of infographics. Results of the validity test calculation against teaching materials are contained in Table 2.

Table 2. Results of the validity of teaching materials.

Assessment Aspects	Validity	
	Average Score	Category
Content Eligibility	3.28	Valid
Presentation Eligibility	3.33	Valid
Language Eligibility	3.23	Valid
Graphic Eligibility	3.35	Valid

Assessment Aspects	Validity	
	Average Score	Category
Validity	3.30	Valid
Reliability	0.85	Very high

The validity of the teaching materials in Table 2 indicates that aspects of content eligibility, eligibility of presentation, language feasibility, and feasibility of infographics have valid categories. The overall result of the validity of the teaching material has a valid category. This shows that the teaching materials of the development results have met the components of suitable teaching materials. Thus, the teaching materials developed deserve to be used in classroom learning as a learning resource for students. The student worksheets validity test consists of several aspects of assessment, namely characteristics of student worksheets format, language, and the content of student worksheets. Results of the validity test calculation against student worksheets are contained in **Table 3.**

Table 3. Student worksheets validity results.

Assessment Aspects	Validity	
	Average Score	Category
Format of student worksheets	3.41	Very Valid
Language	3.27	Valid
Content of student worksheets	3.25	Valid
Validity	3.31	Valid
Reliability	0.83	Very High

The validity of student worksheets in Table 3 shows that aspects of the student worksheets format have very valid categories; language aspects have valid categories, and the content aspect of student worksheets has valid categories. The average result of all aspects obtains validity with valid categories. The results of this valid category validity illustrate that the student worksheets developed have met the competence of good. So it can be said that the student worksheets designed are worth using in learning to train SPS students. The learning outcome test validity test consists of several aspects of assessment. Results of validity test calculations against learning outcome tests are contained in Table 4.

Table 4. Results of validity of learning outcome tests.

Assessment Aspects	Validity	
	Average Score	Category
General Construct	3.57	Very Valid
Language	3.17	Valid
Validity	3.37	Valid
Reliability	0.98	Very High

Table 4 shows that the question's validity in learning outcome tests obtains a valid category. There are two main aspects in making learning outcome tests: the general construction aspect that is categorically very valid and the language aspect that has a valid category. Prastowo (2016) stated that a learning outcome test must be designed by having a learning outcome tests grid and complex components according to indicators and must meet the assessment requirements to obtain a good learning outcome test.

While based on the validity of the aspect of language, it stated that it had completed the criteria of using the correct Indonesian rules and using language that is easy to understand. So it can be said that the learning outcome tests developed are worth using in the learning process.

The practicality of Learning Devices

The implementation of a lesson plan is used to determine the practicality of the learning device developed and observed by two observers for each meeting during the learning process. The implementation of the lesson plan was carried out four times. The learning model used for the four meetings is the guided inquiry model. The results of observations on the implementation of the lesson plan for all meetings are contained in **Table 5**.

Table 5. Results of observation of the implementation of the lesson plan.

Learning Phase	Average Score (Category)			
	1st Meet	**2nd Meet**	**3rd Meet**	**4th Meet**
1. Pay attention and explain the inquiry process	3.60 (VP)	3.70 (VP)	3.90 (VP)	3.80 (VP)
2. Presenting inquiry problems or inappropriate events	3.33 (VP)	3.67 (VP)	3.50 (VP)	3.83 (VP)
3. Ask students to formulate hypotheses to explain problems or events	3.00 (P)	3.33 (VP)	3.67 (VP)	4.00 (VP)
4. Encourage learners to collect data to test hypotheses	3.38 (VP)	3.50 (VP)	3.63 (VP)	3.75 (VP)
5. Formulate explanations or conclusions	2.50 (P)	3.50 (SP)	3.50 (VP)	3.50 (VP)
6. Reflecting on problematic situations and thought processes used to investigate	2.83 (P)	3.33 (VP)	3.67 (VP)	3.67 (VP)
Cover	3.50 (VP)	3.70 (VP)	3.70 (VP)	3.90 (VP)
Validity	3.29 (VP)	3.56 (VP)	3.69 (VP)	3.81 (VP)
Reliability	0.42 (M)	0.71 (H)	0.63 (H)	0.63 (H)

Information: VP = Very Practical; P = Practical; M = Moderate; H = High

The result of the observation of the implementation of lesson plan implementation is in Table 5. Overall, the results of observations of the performance of the lesson plan continue to increase from each meeting. The results of observations on the implementation of lesson plan at the 1st meeting category are practical overall with the reliability of the performance of lesson plan produced by good category. Students are not used to making conclusions independently, so they still need guidance from teachers, especially this happens at 1st meeting, which is still in the stage of adjusting learning to the new model. The first time doing practicum activities, many students were still confused by the learning procedures carried out. The results of observations of the implementation of lesson plan 2nd meeting categories are convenient overall with the reliability of the performance of lesson plan produced by high category. This shows that the learning steps in the lesson plan can be done or implemented completely. This is following Nieveen's opinion in Akker (1998) that the implementation of a lesson plan can be said to be practical if the device is easy and can be implemented in learning.

The results of observations on the implementation of lesson plan 3rd meeting categories are efficient as a whole and for each phase with the reliability of the performance of lesson plan resulting from high category. This shows that the learning steps in the lesson plan implementation can be done or implemented completely. The results of observations on the implementation of lesson plan 4th meeting categories are efficient as a whole and for each phase with the reliability of the performance of lesson plan resulting from high category. This is because at the 4th meeting, relearning is conducive, and students have begun to understand the flow of the learning process based on previous meetings. The results of the validity of learning devices can also affect the practicality of learning devices. A suitable device should be practical and accessible in its implementation and not demand complicated preparations (Widoyoko, 2016). Salam et al., (2016) stated that a valid learning device could make it easier for teachers to guide students in the learning process because it can facilitate teaching and learning activities and student activities become more targeted.

Effectiveness of Learning Devices

The effectiveness of the learning device is reviewed based on student learning outcomes in the form of pre-tests and post-tests to measure students' cognitive abilities, which are then calculated using N-gain. The effectiveness of student N-gain results can be seen in Table 6.

Table 6. Student N-gain results.

Average Pre-test	Average Post-test	N-gain	Category
7.65	51.52	0,47	Moderate

Table 6 shows that the N-gain result acquires a medium category. After being calculated based on N-gain, the acquisition of student learning test results can be effective because it has reached the medium category. The things that affect the student's pre-test score to be low and affect the student's completion value are that students are still less careful in writing down known variables, and the written symbols are not following what has been asked or taught. In addition, in doing the problem of analyzing. Students should explore the relationships between these variables by finding constants to find the relationships between variables mathematically. Misinterpretation when working on this problem by the research of Afriani et al., (2017) States that misunderstanding can occur when students answer questions directly without understanding the meaning of the question. Applying learning materials to physical phenomena in everyday life is also an obstacle for some students. Students have not been detailed in explaining the phenomena presented using concepts that correspond to the material.

Post-test scores increase from pre-test scores because, in each learning, students are constantly reminded of how to analyze experimental data through practicums conducted in the classroom and explanations of the physical equations used during the learning process. Students are also given training questions that are answered, both independently and in groups, and given reinforcement by the teacher after the problem is done. This is in line with the statements of Charli et al., (2018) that the solution that teacher implements decrease the difficulty of students in doing physics problems, namely, providing motivation to students at the beginning of learning and providing problem exercises to students so that students can learn to determine the equations used, write physics symbols correctly, and strengthen the understanding of concepts owned by students.

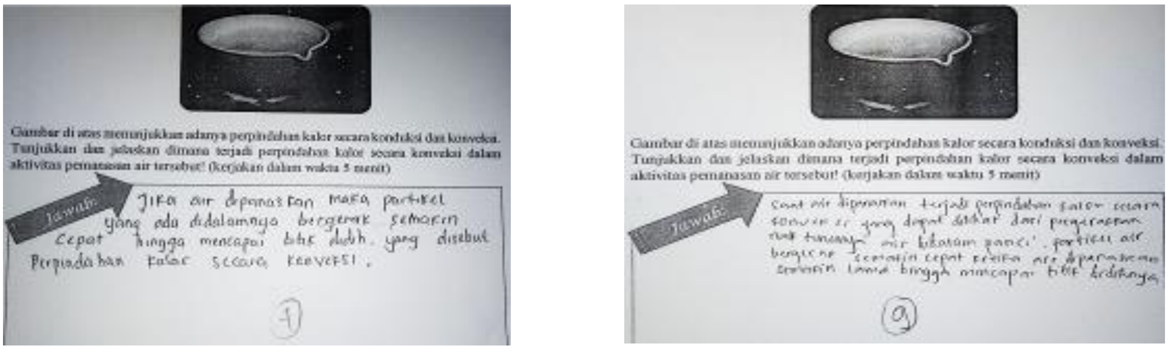

Figure 1. (a) Problems with the cognitive realm of C2 that is not precise and (b) Problems with the proper cognitive realm of C2

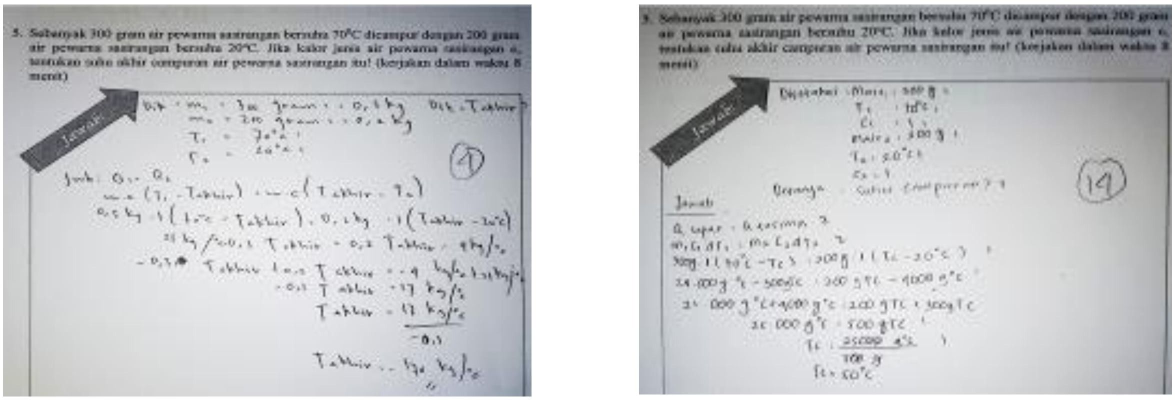

Figure 2. (a) Problems with inappropriate C3 cognitive realms and (b) Problems with the proper C3 cognitive realm

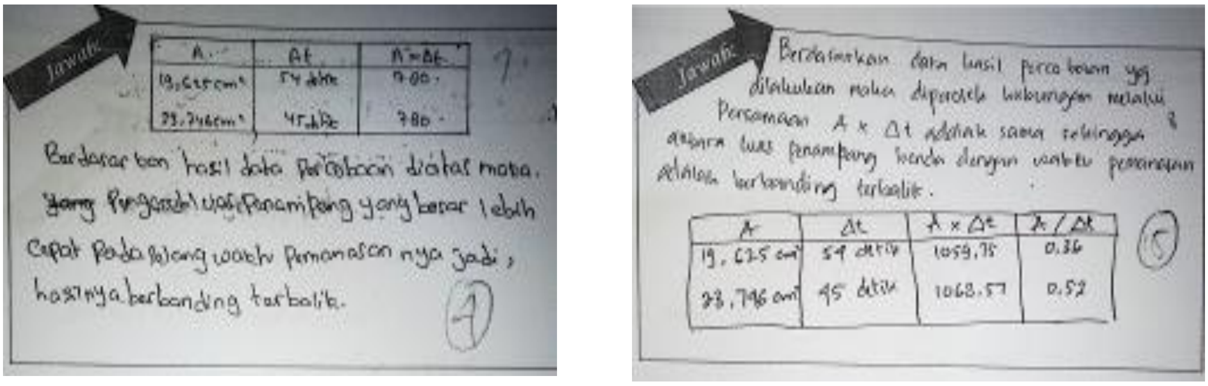

Figure 3. (a) Problems with inappropriate C4 cognitive realms and (b) Problems with the proper C4 cognitive realm

It can also be proven by the presence of six students who can achieve the minimum completion criteria. However, the average results of the post-test obtained showed that the value still did not reach completion. However, students' cognitive abilities have improved, based on the cognitive realm of students, namely C2, C3, and C4, as many as ten questions in the form of essays. In the problem with the cognitive realm of C2, as many as one question obtained an average percentage of 56.5%, while for problems with the cognitive realm of C3, as many as two questions obtained an average percentage of 47.7% and 61.3%. The 7 questions with the cognitive realm of C4 obtained an average percentage of 48.2%, 32.0%, 64.7%, 61.5%, 33.9%, 55.7%, and 72.4%. From the percentage results on questions with the cognitive realms of C2, C3, and C4, it can be concluded that the students who get the lowest scores are in questions with the cognitive realm of C4, based on the percentage result of 32.0%. This result is because many students' answers are still empty in the answer column. After all, students have not been able to understand the questions given, so it impacts the scoring results obtained by students. Here are figures 2, 3, and 4 examples of answers from students in the cognitive realms of C2, C3, and C4 reviewed from precise and incorrect answers.

Another factor that can improve this learning outcome test is temperature and heat learning materials using phenomena that students can find in everyday life, making it easier for students to understand the application of the learned concept. The teaching process is not an activity of transferring the teacher's knowledge to students. Still, teaching is an activity that allows students to learn from their own experiences as their knowledge. The use of guided inquiry models also affects improving student learning outcomes because students are actively involved in learning with the guidance of teachers. A student will more easily remember the knowledge he gained independently and longer compared to the information he gained from listening to others (Ambarsari & Santosa, 2013). This is in line with several studies that show significant improvements in student learning outcomes in terms of cognitive aspects and skills of science processes using guided inquiry learning models (Duran & Dökme, 2016; Serevina & Luthfi, 2021; Subekti & Ariswan, 2016). The average gain of the category shows that practical learning tools are used to improve student learning outcomes, and learning devices have met the minimum category of learning device eligibility.

CONCLUSION

Learning devices with inquiry models guided by temperature and heat materials to practice students' science process skills are worth using because they are proven to meet valid, practical, and effective criteria. The implication of the research shows that learning devices can be one of the alternatives, especially in temperature and heat materials at the High School level. The limitations of this study are still limited to the senior high school level. Therefore, further research can be carried out with a larger number of samples, different materials and different levels of school education.

REFERENCES

Afriani, R., Kade, A., & Supriyatman, S. (2017). Analisis kesalahan siswa dalam menyelesaikan soal fisika tingkat analisis C4. *JPFT (Jurnal Pendidikan Fisika Tadulako Online*, *7*(2), 28–33.

Agustina, B.A.S., Arifuddin, M., & Miriam, S. (2017). Meningkatkan keterampilan proses sains siswa kelas X IPA 1 SMA negeri 1 marabahan menggunakan model pembelajaran guided inquiry. *Berkala Ilmiah Pendidikan Fisika*, *5*(1), 109–117. http://dx.doi.org/10.20527/bipf.v5i1.2899

Alkan, F. (2016). Experiential learning: Its effects on achievement and scientific process skills. *Journal of Turkish Science Education*, *13*(2), 15–26. https://doi.org/10.12973/tused.10164a

Almuntasheri, G., & Wright. (2016). The effectiveness of a guided inquiry-based, teachers' professional development programme on Saudi students' understanding of density. *Science Education International*, *27*(1), 16–39.

Ambarsari, W., & Santosa, S. (2013). Penerapan pembelajaran inkuiri terbimbing terhadap keterampilan proses sains dasar pada pelajaran biologi siswa kelas VIII SMP negeri 7 surakarta. *Jurnal Pendidikan Biologi*, *5*(1), 81–95.

Ansari, B., Zainuddin, Z., & Salam, A. (2017). Meningkatkan keterampilan proses sains dan hasil belajar siswa kelas X-1 SMAN 10 banjarmasin dengan menerapkan model inquiry discovery learning terbimbing. *Jurnal Ilmiah Pendidikan Fisika*, *1*(3), 126–142. https://doi.org/10.20527/jipf.v1i3.1015

Arifuddin, M., Aslamiah, M., Misbah, M., & Dewantara, D. (2020). The implementation of guided inquiry model on the subject matter harmonious vibration. *Journal of Physics: Conference Series, 1422*(1), 012001. https://doi.org/10.1088/1742-6596/1422/1/012001

Arikunto, S. (2013). *Prosedur penelitian suatu pendekatan praktik*. Yogyakarta: Rineka Cipta.

Ayuningtyas, P., Soegimin, W.W., & Supardi, I.A. (2015). Pengambangan perangkat pembelajaran fisika dengan model inkuiri terbimbing untuk melatihkan keterampilan proses sains siswa sma pada materi fluida statis. *Jurnal Penelitian Pendidikan Sains UNESA*, *4*(2), 636–647.

Ballesta-Claver, J., Blanco, A.M. F., & Gómez Pérez, I. A. (2021). A revisited conceptual change in mathematical-physics education from a neurodidactic approach: A pendulum inquiry. *Mathematics*, *9*(15), 1-17. https://doi.org/10.3390/math9151755

Charli, L., Amin, A., & Agustina, D. (2018). Kesulitan siswa dalam menyelesaikan soal fisika pada materi suhu dan kalor di kelas X SMA ar-risalah lubuklinggau tahun pelajaran 2016/2017. *Journal of Education and Instruction (Joeai)*, *1*(1), 42–50. https://doi.org/10.31539/joeai.v1i1.239

Duran, M., & Dökme, I. (2016). The effect of the inquiry-based learning approach on student's critical-thinking skills. *Eurasia Journal of Mathematics Science and Technology Education*, *12*(12), 2887-2908. https://doi.org/10.12973/eurasia.2016.02311a.

Ekici, M., & Erdem, M. (2020). Developing science process skills through mobile scientific inquiry. *Thinking Skills and Creativity*, *36*, 100658. http://dx.doi.org/10.1016/j.tsc.2020.100658

Elnada, I.W. (2016). Meningkatkan Keterampilan proses sains dengan model inkuiri terbimbing pada siswa kelas X PMIA 3 di SMAN 3 banjarmasin. *Berkala Ilmiah Pendidikan Fisika*, *4*(3), 228–236. http://dx.doi.org/10.20527/bipf.v4i3.1851

Ghafar, A. (2020). Convergence between 21st century skills and entrepreneurship education in higher education institutes. *International Journal of Higher Education*, *9*(1), 218–229. https://doi.org/10.5430/ijhe.v9n1p218

Hake, R.R. (1998). Interactive-engagement versus traditional methods : A six-thousand-student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, *66*(1), 64–74. https://doi.org/10.1119/1.18809

Handayani, B.T., Arifuddin, M., & Misbah, M. (2017). Meningkatkan keterampilan proses sains melalui model guided discovery learning. *Jurnal Ilmiah Pendidikan Fisika*, *1*(3), 143–154. https://doi.org/10.20527/jipf.v1i3.1016

Hernawati, D., Amin, M., Irawati, M.H., Indriwati, S.E., & Omar, N. (2018). The effectiveness of scientific approach using encyclopedia as learning materials in improving students' science process skills in science. *Jurnal Pendidikan IPA Indonesia*, *7*(3), 266–272. https://doi.org/10.15294/jpii.v7i3.14459.

Hidayat, M.W., Zainuddin, Z., & Salam, A. (2016). Pengembangan perangat pembelajaran fisika pada pokok bahasan listrik dinamis menggunakan model pebelajaran inkuiri terbimbing. *Berkala Ilmiah Pendidikan Fisika*, *4*(1), 21–26. http://dx.doi.org/10.20527/bipf.v4i1.1027

Ihsan, I.N., Jamal, M.A., & Salam, A. (2017). Pengembangan perangkat pembelajaran berorientasi lingkungan sekitar bantaran sungai barito untuk melatihkan keterampilan proses sains. *Berkala Ilmiah Pendidikan Fisika*, *5*(1), 29–45. http://dx.doi.org/10.20527/bipf.v5i1.2224

Inayah, A.D., Ristanto, R.H., Sigit, D.V., & Miarsyah, M. (2020). Analysis of science process skills in senior high school students. *Universal Journal of Educational Research*, *8*(4 A), 15–22. https://doi.org/10.13189/ujer.2020.081803

Karim, M.A., Zainuddin, Z., & Mastuang, M. (2016). Meningkatkan keterampilan proses sains siswa kelas VIII B SMP negeri 10 banjarmasin menggunakan model pembelajaran inkuiri terbimbing. *Berkala Ilmiah Pendidikan Fisika*, *4*(1), 44–51. http://dx.doi.org/10.20527/bipf.v4i1.1039

Khaerunnisa, K. (2017). Analisis keterampilan proses sains (fisika) SMA di kabupaten Jeneponto. *Jurnal Pendidikan Fisika-Journal of Physics Education*, *5*(3), 340–350. https://doi.org/10.26618/jpf.v5i3.855

Koksal, E.A., & Berberoglu, G. (2014). The effect of guided-inquiry instruction on 6th grade Turkish students' achievement, science process skills, and attitudes toward science. *International Journal of Science Education*, *36*(1), 66–78. https://doi.org/10.1080/09500693.2012.721942

Komariah, U.H., Jamal, M.A., & Misbah, M. (2017). Meningkatkan keterampilan proses sains melalui model inquiry discovery learning terbimbing pada pokok bahasan fluida statis di kelas XI IPA 4 SMAN 11 banjarmasin. *Berkala Ilmiah Pendidikan Fisika*, *5*(3), 309–327. http://dx.doi.org/10.20527/bipf.v5i3.3876

Limatahu, I., & Mubarok, H. (2020). CCDSR learning model: Innovation in physics learning. *IJORER: International Journal of Recent Educational Research*, *1*(1), 19–29. https://doi.org/10.46245/ijorer.v1i1.13

Maknun, J. (2020). Implementation of guided inquiry learning model to improve understanding physics concepts and critical thinking skill of vocational high school students. *International Education Studies*, *13*(6), 117–130. http://dx.doi.org/10.5539/ies.v13n6p117

Mills, L.A., Knezek, G., & Khaddage, F. (2014). Information seeking, information sharing, and going mobile: Three bridges to informal learning. *Computers in Human Behavior*, *32*, 324–334. http://dx.doi.org/10.1016/j.chb.2013.08.008

Misbah, M., Dewantara, D., Hasan, S. M., & Annur, S. (2018). The development of student worksheet by using the Guided Inquiry Learning Model to train student's scientific attitude. *Unnes Science Education Journal*, *7*(1), 19–26. https://doi.org/10.15294/USEJ.V7I1.15799

Nnorom, N.R. (2016). Effect of investigative laboratory approach and expository method on acquisition of science process skills by biology students of different level of scientific literacy. *African Journal of Education, Science and Technology*, *3*(2), 214–219.

Nusantari, E., Abdul, A., Damopolii, I., Alghafri, S.R., & Bakkar, B.S. (2021).

Combination of discovery learning and metacognitive knowledge strategy to enhance students' critical thinking skills. *European Journal of Educational Research*, *10*(4), 1781–1791. https://doi.org/10.12973/EU-JER.10.4.1781

Pamenang, F.D.N., Harta, J., Listyarini, R.V, Wijayanti, L.W., Ratri, M.C., Hapsari, N.D., & Lee, W. (2020). Developing chemical equilibrium practicum module based on guided inquiry to explore students' abilities in designing experiments. *Journal of Physics: Conference Series*, *1470*(1), 12097.

Peterson, C. (2003). Bringing ADDIE to life: Instructional design at its best. *Journal of Educational Multimedia and Hypermedia*, *3*(12), 227–241.

Prastowo, A. (2016). *Pengembangan bahan ajar tematik tinjauan teoritis dan praktis*. Surabaya: Kencana.

Pratono, A., Sumarti, S.S., & Wijayati, N. (2018). Contribution of assisted inquiry model of e-module to students science process skill. *Journal of Innovative Science Education*, *7*(1), 62–68. https://doi.org/10.15294/jise.v7i1.20633

Ramberg, U., Edgren, G., & Wahlgren, M. (2021). Capturing progression of formal knowledge and employability skills by monitoring case discussions in class. *Teaching in Higher Education*, *26*(2), 246–264. https://doi.org/10.1080/13562517.2019.1657396

Sabahiyah, S., & Marhaeni, A.A.I.N. (2013). Pengaruh model pembelajaran inkuiri terbimbing terhadap keterampilan proses sains dan penguasaan konsep IPA siswa kelas V gugus 03 wanasaba lombok timur. *Jurnal Pendidikan Dasar Ganesha*, *3*(1).

Salam, A., Miriam, S., Arifuddin, M., & Ihsan, I.N. (2016). Pengembangan bahan ajar berbasis lingkungan bantaran sungai barito untuk melatihkan keterampilan proses sains siswa. In *Prosiding Seminar Nasional Lahan Basah Tahun 2016 Universitas Lambung Mangkurat,* 684–688.

Serevina, V., & Luthfi, K. (2021). Development of discovery learning based on online learning tools on momentum and impulse. *Journal of Physics: Conference Series*, *1876*(1), 12076.

Subekti, Y., & Ariswan, A. (2016). Pembelajaran fisika dengan metode eksperimen untuk meningkatkan hasil belajar kognitif dan keterampilan proses sains. *Jurnal Inovasi Pendidikan IPA*, *2*(2), 252–261. https://doi.org/10.21831/jipi.v2i2.6278

Ural, E. (2016). The Effect of Guided-Inquiry Laboratory Experiments on Science Education Students' Chemistry Laboratory Attitudes, Anxiety and Achievement. *Journal of Education and Training Studies*, *4*(4), 217–227. http://dx.doi.org/10.11114/jets.v4i4.1395

Wang, J., Guo, D., & Jou, M. (2015). A study on the effects of model-based inquiry pedagogy on students' inquiry skills in a virtual physics lab. *Computers in Human Behavior*, *49*, 658–669. http://dx.doi.org/10.1016/j.chb.2015.01.043

Widoyoko, E.P. (2016). Evaluasi program pembelajaran. In *Evaluasi Program Pembelajaran*. Yogyakarta: Pustaka Pelajar.

Zainuddin, Z., & Misbah, M. (2021). Efektivitas perangkat pembelajaran fisika fluida berbasis lingkungan lahan basah. *Jurnal Inovasi dan Pembelajaran Fisika*, *08*(2), 136–143. https://doi.org/10.36706/jipf.v8i2.11158

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