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Development of Pictorial Riddle-Based Guided Inquiry Model Learning Devices to Improve Students' Problem Solving Ability

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Abstract: This research is in the form of development which aims to produce products in the form of pictorial riddle-based guided inquiry learning tools that are valid, practical, and effective to improve students' problem-solving abilities. The flow of development research stages uses a 4D model consisting of defining, designing, developing, and disseminating. The products developed are Learning Implementation Plans, Teaching Materials, Student Worksheets, Learning Media, and problem-solving ability test instruments. Data collection techniques were carried out through the validation of learning tools by validators, student response questionnaires, observation sheets of learning implementation, and test instruments. The results of the validation of learning tools reach an average validity value of 79.347% with valid criteria. The students' responses obtained a score of > 80% with good criteria and the average learning implementation for three meetings was 3.5 with good criteria. The effectiveness of the developed learning tools can be analyzed by calculating the t-test. Based on calculations using the t-test, the results obtained are $t_{count} > t_{table}$, namely 17.270 > 1.729. The results of the N-gain calculation of students' problem-solving abilities are 0.6075 with moderate criteria. Based on the results of this study, it can be concluded that the guided inquiry learning model based on pictorial riddles to improve students' problem-solving abilities is valid, practical, and effective in learning.

Keywords: Guided inquiry models, pictorial riddles, problem solving abilities

Introduction

Education is an effort to build civilization, as a form of life activity in society to create a complete human being that lasts a lifetime (Mulyasa, 2013). In order to achieve an educational goal it is necessary to have educational standards, one of which is process standards. The learning process in educational units is held in an interactive, inspiring, and fun way (Kemendikbud, 2013). What can be done to create fun and meaningful learning (joyful and meaningful learning) is to develop learning tools that suit the characteristics of students and the environment (Azmi et al, 2021)

In the physics learning process, teachers are required to be creative in compiling and applying various interesting learning methods or models to arouse students' interest in learning (Sahidu, 2018). Physics learning must be directed at obtaining information and acting so that it can help students acquire in-depth concepts, therefore it is necessary to emphasize providing direct experience centered on students (Yerita et al, 2017). Under the expected conditions, the physics learning process should be able to make students like and active in finding knowledge and knowing more about physics material (Yulianci et al, 2017).

In fact, learning physics in schools is still not optimal. This is due to the use of less varied learning methods. Various problems were found when researchers made observations which included the use of less varied learning methods (discussions, lectures, and questions and answers), and inadequate learning facilities. In the process of learning physics at school, students still think that physics is a difficult lesson, with too many equations, boring, and causes low student learning outcomes, especially problem-solving abilities. This can be from the results of students' problem-solving ability tests when solving or answering questions given by researchers.

Based on the various problems found, the researcher developed a learning tool that is expected to be a solution to solving the various problems described earlier. Research on the development of learning tools is carried out based on active learning models that can improve student achievement, especially problem-solving skills, and create a fun learning environment, one of which is the guided inquiry learning model based on pictorial riddles. The learning model will determine the effectiveness of a lesson.

The guided inquiry learning model is a learning model that helps students gain knowledge by discovering it themselves (Sumarni, 2020). According to Haidir (2012), the teacher's most important role is to ask and give questions, provide accurate responses, and properly structure the subject matter that will be conveyed to students.

According to Chusni (2016), the pictorial riddle method is a method for developing students' motivation and interest in small and large group discussions. The pictorial riddle method usually uses images or the like. Images or demonstrations, or actual situations can be used to improve students' critical and creative thinking. A riddle is usually in the form of an image on a blackboard, poster board, on a student activity sheet, or projected from a transparency, then the teacher asks questions related to the riddle.

Problem-solving ability is a high-level cognitive ability, the problem-solving thinking stage after the evaluation stage which is part of the cognitive stages of Bloom's taxonomy (Venisari, 2015). Problem-solving abilities can bring students to find ideas to apply and find a solution. According to Rokhmat (2013), problem-solving is the ability to use the knowledge one has in choosing and or predicting deductively various possible consequences of a phenomenon, which contains one or several given causes, and being able to identify how these causes can produce the selected or predicted results. Azizah et al (2016) stated that problem-solving abilities require special abilities and skills from an individual person, which may differ in problem-solving. The difference between those who have low and high abilities in solving physics problems is how to organize and use knowledge and relate one concept to another when solving problems. Problem-solving ability has several indicators, Xin et al (2005) revealed problem-solving indicators namely (1) Identifying problems, (2) Planning to solve problems, (3) Solving problems, and (4) Re-checking.

According to Malida (2019), guided inquiry learning tools have advantages including that students better understand basic concepts and can encourage students to express their ideas; Through pictorial puzzles, the material provided can be better recorded in students' memories and encourage students to think critically so that students can issue their initiatives. Guided inquiry is part of contextual-based learning activities. The knowledge and skills acquired by students are expected not to be the result of remembering a set of facts, but the result of finding them yourself. Then the guided inquiry learning model is very suitable to be used to improve students' problem-solving abilities because this model involves students in collecting existing or new data and information to solve real problems. Syntax in learning using the guided inquiry model supports improving problem-solving skills which consist of five stages, namely orientation, exploration, concept formation, application, and closing (Rohmayanti, 2015).

Based on the explanation of this background, the researcher chose to research with the title "Development of pictorial riddle-based guided inquiry learning tools to improve students' physics problem-solving abilities". It is hoped that the development of guided inquiry physics learning tools can make students more interested in receiving and processing information provided by the teacher and students can be more active during the learning process so that students' physics problem-solving abilities increase.

Methode

This study uses the Research and Development (R&D) method, with the research design using the 4D model which consists of the Define, Design, Develop, and Disseminate stages.

The Define stage is carried out by observing and interviewing physics teachers regarding the problems encountered during the learning process. The purpose of this stage is to obtain information about the characteristics of students, problems that arise during the learning process, learning methods, and media used, and examine the curriculum used.

Next, is the design stage (design). This stage resulted in the design of the product that had been developed in the form of a guided inquiry learning model based on pictorial riddles to improve students' problem-solving abilities.

Furthermore, the development stage is the stage of evaluating the product being developed by the validator. Quantitative data was obtained from validation results by three expert validators and three practicing validators. In addition, the assessment was obtained from the results of the implementation of learning for three meetings and the results of

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student response questionnaires. Then a limited trial was carried out with 20 students.

The final stage is the dissemination stage. At this stage, it was not implemented due to time and cost constraints. However, as an alternative, the results of the products developed are outlined in scientific articles and reporting on the results of the thesis.

This research was carried out at MA NW Hikmatusysyarief Narmada with the research subjects being students of class X MIPA 2 in the 2021/2022 academic year. Data collection was carried out by providing validation sheets, questionnaires on the implementation of learning responses, and test instruments. The validation sheet is used to determine the validity of a learning device, a response questionnaire is used to determine the practicality of the learning device, and the provision of test instruments is used to determine the effectiveness of the learning device.

The assessment on the validation sheet is assessed using a Likert scale with points 1 to 4, with criteria 1 = very less, 2 = less, 3 = good, and 4 = very good (Fatmawati, 2016). The formula used to calculate the percentage of product validity.

$$Validity\ (V) = \frac{validation\ score}{Maximum\ total\ score}\ x100\%$$

The percentage data obtained is then converted into learning device validity criteria as seen in Table 1 below.

Table 1: Criteria for the Validity of Learning Devices

Score	Criteria
85,01 % - 100%	Very Valid
70,01% - 85,00%	Valid
50,01% - 70,00%	Valid Enough
1,00% - 50,00%	Invalid

Akbar (2013)

Furthermore, the reliability test of learning devices that have been developed is also carried out. According to Sugiyono (2010), the reliability test is carried out to find out how far the measurement results remain consistent if measurements are made twice or more for the same symptoms using the same measurement tool. Reliability calculations are performed using Percentage of Agreement (PA) analysis, the percentage of agreement between raters is a percentage of conformity values between raters. The percentage of Agreement can be analyzed using the equation:

$$(PA) = \left(1 - \frac{A - B}{A + B}\right) 100\%$$

Keterangan:

PA : Percentage of Agreement
A : The highest validator value for one variable
B : The lowest validator value for one variable

If the percentage agreement value is more or equal to 75%, the instrument can be said to be reliable. If the resulting value of the percentage agreement is less than 75%, it should be tested for clarity and approval from observers (Borich, 1994).

The practicality of learning data was obtained from the results of student response questionnaires and observation sheets of the implementation of learning. To determine the average percentage of student responses, the following equation is used.

$$Response = \frac{score\ obtained}{max\ score}\ x\ 100\%$$

The observation sheet of the implementation of learning is obtained through the observer's assessment of each implementation of learning. Observation data of the implementation of learning is analyzed using the equation.

$$Practical\ value = \frac{score\ obtained}{max\ score}\ x\ 100\%$$

The practicality value obtained is then interpreted based on practicality criteria. The level of practicality of the instrument is determined based on Table 2 below..

Table 2: Learning Implementation Criteria

Score (%)	Criteria
3,6 – 4,0	Very Good
2,6 – 3,5	Good
1,6 – 2,5	Not Good
0 – 1,5	Very Not Good

Fatmawati (2016)

Analysis of learning effectiveness is obtained by calculating the average difference between students' pre-test and post-test scores through the re-observation t-test calculation. To test the significance of the t value, repeated observations are carried out by comparing the calculated t value with t table at a predetermined significance level and certain degrees of freedom (Nuryadi et al, 2017). Calculation of the t-test can be calculated by the following formula.

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$$t = \frac{\overline{D}}{\frac{SD}{\sqrt{n}}}$$

Keterangan:
t = t value for repeated observations
$\overline{D}$ = The average difference in measurements 1 and 2
SD = The standard deviation
n = number of samples

Analysis of the effectiveness of learning tools is measured by increasing the pretest and posttest scores of students which are then analyzed using the N-Gain test. The formula for calculating the N-Gain test is as follows.

$$< g > = \frac{pretest\ score - posttest\ score}{maximum\ score - pretest\ score}$$

The N-Gain calculation obtained is then interpreted using the classification in Table 3 below.

Table 1: Effectiveness Criteria

Value Range	Criteria
N-gain > 0,7	High
0,3≤ N-gain ≤ 0,7	Medium
N-gain< 0,3	Low

Sundayana (2015)

Result and Discussion

The research products that have been developed are in the form of syllabi, lesson plans, teaching materials, Student Worksheets, learning media, and test instruments of Problem-Solving Ability (PSA), then tested for feasibility, practicality, and effectiveness of their use in learning.

The feasibility of learning devices is reviewed from the value of the results of validity and reliability. The validity value was obtained from the validation results carried out by 3 (three) expert validators from physics education lecturers at FKIP University of Mataram and 3 practicing validators, namely physics teachers, while the reliability value was obtained from the calculated results using the percentage of agreement method. The learning device is said to be feasible if the validity assessment is in the valid criteria and the reliability calculation is in the reliable criteria. The results of the validity and reliability of learning devices can be seen in Table 5 below.

Table 5: Results of the analysis of the validity and reliability of learning devices

Product	Validity	Validity Criteria	Reliability	Reliability Criteria
Lesson Plans	82,08%	Valid	95,521%	Reliable
Teaching Materials	76,85%	Valid	88,728%	Reliable
Student Worksheets	78,33%	Valid	91,372%	Reliable
Learning Media	80,83%	Valid	90,895%	Reliable
Instrumen Tes	79,17%	Valid	89,582%	Reliable
Average	**79,45%**	**Valid**	**91,22%**	**Reliable**

Analysis of the practicality assessment data of learning devices tested on students includes student worksheets and PSA test instruments. The closer to 100%, the better the student's response to learning. The results of the practicality analysis can be seen in table 6.

Table 6: Results of student response analysis

	Product	Percentage	Criteria
1	Student Worksheets	84,5 %	Good
2	Test Instruments	86,25%	Good

Based on the results of the practicality analysis by the students, indicated that the students responded well to the Student Worksheets, as well as the PSA test instruments developed. The analysis of learning implementation aims to determine the practicality of learning devices through direct observation by 3 observers. This observation is assessed from the teacher's ability to manage learning, as well as student activities during learning. The assessment used is in the form of observation sheets of the implementation of learning for 3 meetings. The results of the analysis of the implementation of learning can be seen in Table 7.

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Table 7: Results of Analysis of Learning Implementation

Meeting	**Implementation of Learning**			**Average Score**	**Criteria**
	Observer 1	**Observer 2**	**Observer 3**		
1	3,3	3,3	3,3	3,3	Good
2	3,4	3,7	3,6	3,5	Good
3	3,6	3,8	3,6	3,6	Very Good
Average				**3,5**	Good

Based on the results of the analysis in Table 7, the overall average value of learning implementation is 3.5 with good criteria.

The effectiveness of learning tools can be seen from the analysis of the data on the increase in PSA of students after limited trials were carried out by applying the guided inquiry learning model. Limited trials were conducted on 20 students. The effectiveness of the developed learning tools can be analyzed by calculating the t-test. Based on the calculation using the t-test, the results obtained are $t_{count}>t_{table}$, namely 17.270 > 1.729, so based on the existing hypothesis, H_0 is rejected while H_a is accepted.

Furthermore, to determine the increase in the PSA of students can be analyzed by calculating the N-gain. The results of the PSA analysis can be seen in Table 8 and Table 9 below.

Table 8: Average Analysis Results per PSA Indicator Using N-gain Calculations

	Indicator of PSA	***N-gain***	**Criteria**
1	Identifying Problems	0,5	Medium
2	Problem solving planning	0,37	Medium
3	Problem solving	0,66	Medium
4	Back check	0,90	Medium
	Average	**0,61**	**Medium**

Based on the results of the analysis in table 8, the average N-gain value for the PSA indicator is 0.61 with moderate criteria. Next for the results of the analysis in Table 9.

Table 9: Results of Analysis of PSA Criteria Using N-gain Calculations

N-gain	**Criteria**	**Percentage**
$0,70 \leq g \leq 1,00$	Tinggi High	45%
$0,30 \leq g < 0,70$	Medium	55%
$0,00 < g < 0,30$	Low	0%

Furthermore, for the results of the analysis in Table 9, the results of the N-gain high criteria were 9 students with a percentage of 45%, and medium criteria were 11 students with a percentage of 55%. This value indicates an increase in PSA, which interprets that the development of guided inquiry model learning tools based on pictorial riddles is to improve students' problem-solving abilities.

The feasibility of learning devices is reviewed from the value of the results of validity and reliability. Assessment of learning tools was carried out by three expert validators and three practitioner validators using validation sheets using a Likert scale of 1-4. The scores obtained from the validity and reliability results of learning devices averaged 79.45% and 91.22% with valid criteria and reliability. According to Arikunto (2006), the learning tools and instruments developed show an average yield of more than 75% so it can be concluded that the product developed is valid with a very feasible category. In addition, in a book developed by Borich (1994), a learning device is said to be reliable if the percentage agreement value is more than or equal to 75%. Based on the scores, validity, and reliability criteria obtained, it can be concluded that the learning tools that have been made are feasible to be applied in learning.

Practicality The practicality of learning devices is determined through an analysis of the assessment of student responses, as well as the implementation of learning. Student responses aim to determine the practicality of learning tools that have been developed from the point of view of students as research subjects. Learning tools assessed by students include Student Worksheets and PSA test instruments. The average practicality percentage based on student responses for each Student Worksheet and PSA test instrument is 84.5% and 86.25%. The closer to 100%, the better the student's response to learning (Fatmawati, 2016). Based on this, it can be concluded that the Student Worksheets and the PSA test instrument of the guided inquiry model are practical to apply in learning.

Assessment of the implementation of learning aims to determine the practicality of learning devices through observation by 3 observers. The assessment sheet used is in the form of an observation sheet with 3 learning meetings. Based on the results of the analysis of the implementation of learning, the average value at the first meeting was 3.3 with good criteria, the second meeting was 3.5

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with very good criteria and the third meeting was 3.6 with very good criteria. The overall average of learning implementation reached 3.5 with very good criteria. This is in accordance with what was explained by Fatmawati (2016) that the implementation of learning is classified as a very good criterion if it reaches a value of 3.5 to 4.0. Santi & Santoso (2016) further explained that learning tools can be said to be practical if the implementation of learning is at least in good criteria. Based on the results of data analysis and explanations that have been described, it can be concluded that the guided inquiry learning model is practically used in learning.

The effectiveness of learning tools can be seen from the analysis of data on the increase in PSA of students after limited trials were carried out by applying a problem-based learning model. Limited trials were conducted on 20 students. The effectiveness of the developed learning tools can be analyzed by calculating the t-test.

Based on the calculation using the repeated observation t-test, the results obtained are t_count>t_table, namely 17.270 > 1.729 so based on the existing hypothesis, H_0 is rejected while H_a is accepted. Furthermore, to determine the increase in the PSA of students can be analyzed by calculating the N-gain. The results of the PSA analysis can be seen in Table 8 and Table 9. Based on the results of the analysis in Table 8, the average N-gain value for the PSA indicator is 0.61 with moderate criteria. This is in line with Sundayana (2015) which states that the N-gain value is in the moderate category if it is at an interval of 0.30 $\leq$g <0.70.

Furthermore, for the results of the analysis in Table 9, the results of the N-gain high criteria were 9 students with a percentage of 45% and medium criteria were 11 students with a percentage of 55%. This value indicates an increase in PSA, which interprets that the development of guided inquiry model learning tools based on pictorial riddles is effective for increasing students' problem-solving abilities.

Conclusion

Based on the results of the research and discussion, it is concluded that the development of pictorial riddle-based guided inquiry learning tools is valid, practical, and effective for improving students' problem-solving abilities.

There are several suggestions for improving development research at a later stage, namely; (1) for future researchers who wish to conduct research in the same place, it is hoped that they can and are able to streamline learning time considering that the allocation of learning time is very less, (2) for schools, it is expected to be able to facilitate facilities and infrastructure such as experimental tools to support subjects which necessitate carrying out experimental experiments.

References

Arikunto, S. (2006). *Prosedur Penelitian Suatu* Pendekatan *Praktik*. Jakarta: Rineka Cipta.

Azizah, R., Yuliati, L. & Latifah E. (2016). Kemampuan Pemecahan Masalah Melalui Pembelajaran Interactive Demonstration Siswa Kelas X SMA pada Materi Kalor. *Jurnal Pendidikan Fisika dan Teknologi. 2(2), 55-60. Doi:* 10.29303/jpft.v2i2.289

Azmi, B., Dessolina, D., Kristina, E., Pratiwi, M., Handayani, N., Freticilia, S. G., & Leonard, L. (2021). Pengembangan Media Pembelajaran Rolling Ball untuk Materi Fungsi dan Invers. *Journal of Instructional Development Research*, *2*(2), 69-80. Retrieved from: https://eduresearch.web.id/index.php/jidr/article/view/15

Borich, G. D. (1994). Observation *Skill for Effective Teaching*. New York: Mac Millian Publishing Company.

Fatmawati, A. (2016). Pengembangan perangkat pembelajaran konsep pencemaran lingkungan menggunakan model pembelajaran berdasarkan masalah untuk SMA kelas X. *Edu Sains: Jurnal Pendidikan Sains dan Matematika*, *4* (2), 94-103. Doi: https://doi.org/10.23971/eds.v4i2.512

Haidir, & Salim. (2012). *Strategi Pembelajaran*. Medan: Perdana Publishing.

Kemdikbud. (2013). *Undang-Undang Nomor 20* tahun *2013 tentang Sistem Pendidikan Nasional.*

Malida, aster Indah dan Jumadi, Jumadi. (2019). Pengembangan Perangkat Pembelajaran Berbasis Inquirypictorial Riddle Untuk Meningkatkan Hasil Belajar Fisikaaspek Kognitif Ditinjau Dari Motivasi. *Universitas Negeri Yogyakarta*. Retrieved from https://eprints.uny.ac.id/65129/

Mulyasa. (2013). *Pengembangan dan Implementasi Kurikulum*. Bandung: PT Remaja Rosda Karya.

Nuryadi, N., Astuti, T. D., Utami, E. S., Budiantara. M. (2017). *Dasar- Dasar Statistik Penelitian.* Yogyakarta: Sibuku Media.

Rokhmat, J. (2013). Peningkatan Kemampuan Pemecahan Masalah Mahasiswa Calon Guru Fisika melalui Berpikir Kausalitas dan Analitik. *Disertasi. Universitas Pendidikan Indonesia: tidak diterbitkan.*

Sahidu, C. (2018). *Profesi Keguruan Abad 21*. Mataram:Arga Puji Press.

Sugiyono, (2010). *Metode Penelitian Kuantitatif Kualitatif Dan R & D*. Bandung: Alfabeta.

Sumarni, S., Kosim, K., Verawati, N. N. S. P. (2020). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbantuan Simulasi Virtual Terhadap Penguasaan Konsep Fisika Peserta Didik SMA. *Jurnal Pendidikan Fisika dan Teknologi*, *6(2)*. Retrieved from: https://jurnalfkip.unram.ac.id/index.php/JPFT/article/view/2042/pdf

Sundayana, R. (2015). *Statistik Penelitian Pendidikan*. Bandung: Alfabeta.

Venisari, R. Gunawan., Sutrio. (2015). Penerapan Metode Mind Mapping pada Model Direct Instruction Untuk Meningkatkan Kemampuan Pemecahan Masalah Fisika Siswa Smpn 16 Mataram. *Jurnal Pendidikan Fisika dan Teknologi. Vol 1(3)*. Doi: 10.29303/jpft.v1i3.258

Yerita, S., Wahyudi, W., & Rahayu, S. (2017). Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Penguasaan Konsep dan Kemampuan Berpikir Kritis Fisika Peserta Didik Kelas X SMAN 1 Kuripan Tahun Ajaran 2017/2018. Jurnal Pendidikan Fisika dan Teknologi, 3(2): 181-187. Doi: 10.29303/jpft.v3i2.398

Yulianci, S., Gunawan, G., & Doyan, A. (2017). Model Inkuiri Terbimbing Berbantuan Media Interaktif untuk Meningkatkan Penguasaan Konsep Fisika Peserta Didik. Jurnal Pendidikan Fisika dan Teknologi, 3 (2): 146. Doi: 10.29303/jpft.v3i2.365