

The Effect of E-Learning Based Worksheet to Improve Problem Solving Ability of Senior High School Students

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ABSTRACT

This research was conducted to determine the increase in problem solving abilities in senior high school students. This research method is experimental research, using 2 classes. Sampling using purposive sampling with certain considerations by knowing the conditions or situations under study. Modelling class and implementation class. Data collection used the pre-test and post-tests to determine the increase in students' problem-solving abilities. The results of the analysis using sign test analysis obtained from data collection show that in the modelling class the value of $\alpha = 0.003$ is obtained. The implementation class gets a value of $\alpha = 0.001$. The results of the analysis show $\alpha < 0.05$ that the modelling class has improved problem-solving abilities that are better for students after using the worksheet that has been developed compared to the implementation class.

Keywords: *Worksheet, E-learning, Problem solving*

1. INTRODUCTION

Problems are new situations or things faced by individuals and there is no method or way to solve them [1]. [2] say that the problem is a situation that does not have a direct solution or a known solution strategy. Something that occurs due to differences between the goal and what is happening [3] and the unavailability of solutions to problems [4]. Problem solving is seen as a process when a person is able to overcome a challenge and then find what is the target of his achievement [5]. A person needs to train his ability to solve problems by solving various kinds of problems so that experience is gained and ultimately can solve every problem in life [6]. This is because solving problems can increase long-term memory of problems and solutions [7]

Problem solving by using the rule of thumb strategy, [8] the formulation of the strategy is known as IDEAL, which includes: (1) problem identification; (2) defining and representing the problem; (3) strategic exploration; (4) implementing the strategy; (5) look back and evaluate. This step makes it easier for

students to give their way to go through problems and help teachers focus on one or more problem-solving exams for learning and assessment. Indicators or problem-solving steps according to [9] include: (1) understanding the problem, this can be done by rewriting the problem in its own language that can be more understandable and more operational; (2) make a plan or a way to solve it, here also presumptions of possible answers; (3) carry out the plan made in point 2 or solve the problem according to the plan that has been prepared; (4) see or check the correctness of the answers obtained. [10] also describes problem solving indicators, including focusing on problems, describing problems, planning solutions, executing plans, evaluating problem solving solutions. Problem solving phases include: orientation, planning, implementation, examination [11]. Strategies or ways of solving problems are based on the problem itself, the use of methods or ways of solving problems, solving problems based on trial and error, and starting solutions by applying the appropriate method.

Introducing a problem solving in school the need for learning methods with appropriate methods.

According to [12] that students' problem-solving abilities can increase if using very appropriate learning methods besides this, it also improves thinking skills and intellectual skills. The use of problem-solving learning methods will be maximized if it is collaborated with the use of media. In accordance with the conditions in schools that are adequate with online media. [13], revealed that the use of media is important because of the strategic position of the media for successful learning.

Physics learning activities, mostly through the problem-solving process can find solutions to problem exercises [14]. The process of problem-solving students uses patterns and concepts that are not commonly used and found in the classroom to gain new experiences [15]. The solution to solving problems in physics learning requires strategies, tactics, and ways to solve them [16]. Practicing problem solving in students can improve their decision making, tension, self-governance and responsibility [17]. Learning that uses problem solving, the teacher as a facilitator for students to share information and explore different strategies among students, then the teacher asks questions related to the problems given to strengthen the students' conceptual understanding [18].

The main factor in physics education is problem solving practice [19], [20]. Problem-solving skills are an important component in some physics lessons. With the aim that students have good abilities in overcoming problems faced when going directly to the field [19]. Problem solving is an ability that needs to be developed in learning because it includes thinking skills to draw conclusions from a problem at hand. The students' problem-solving abilities on impulse, momentum, and momentum impulse theorems were still not optimal for indicators of applying strategies and evaluating solutions [21]. Physics learning in schools tends to emphasize mastery of concepts and less focus on developing student problem solving so that the ability of students to solve problems is still low [22], [23]. application of effective problem-solving strategies to improve the skills of students in solving problems on momentum and impulse material [24]. Students are able to solve physics problems, especially momentum and impulse material, with complex thinking not only by memorizing formulas.

Students have difficulty when dealing with complex problems, students who have low ability in solving physics problems tend to recognize problems based on the problem presentation (surface feature), do not conduct evaluations, and tend to use formulas in solving problems [25]. Physics teachers have not been

effective in practicing problem-solving skills, so that students lack even problem-solving skills [26]. In addition, the difficulty in problem solving is caused by a weak understanding of the principles and rules of physics, a deficiency in understanding the problems, and insufficient motivation from students [27]. So that the teacher factor in teaching and learning methods is a key to success in increasing a student's problem-solving ability. According to [28] the teacher needs to change the learning method so that physics lessons are more fun, make students motivated and students more active in learning

The teaching and learning process will be active, effective, creative, interesting and fun if it is supported by the availability of teaching materials, and one of the teaching materials that can be used is Worksheet [29]. According to [30], Worksheet will help effective interaction between teachers and students. By using Worksheet students will have more active opportunities in learning activities, thus helping teachers in carrying out the learning process. One of the learning tools used in the learning process is the Student Activity Sheet (Worksheet). Observations and interviews conducted by [31] in the use of conventional Worksheet in schools will create a monotonous learning atmosphere and students will feel bored following the lessons. This has an effect on student learning outcomes that are not satisfactory, because from the Minimum Completeness Criteria (KKM) which has a value of 70, only 15% of children have succeeded in understanding the material of momentum, impulse and collision with the standard value of KKM, therefore Worksheet is needed in accordance with learning needs so that learning objectives can be achieved. The benefits of using Worksheet for learning activities according to [32] are:

- a) Enabling students in the learning process.
- b) Helping students in developing concepts.
- c) Train students in discovering and developing process skills.
- d) Train students to solve problems and think critically.
- e) As a guide for teachers and students in carrying out the learning process.
- f) Helping students get notes about the material studied through learning activities.
- g) Helping students add information about the concepts learned through systematic learning activities.

Electronic-based learning process (E-learning). One of the media used is a computer network. With the development of a computer network, it is possible to develop a web-based teaching and learning process, so that it can be developed into a wider computer network, namely the internet. The e-learning system using the internet is also called internet enabled learning. The presentation of this web-based E-

learning can be more interactive. [33]. E-learning provides new hope as an alternative solution to most educational problems in Indonesia, with functions that can be adjusted according to needs, either as a supplement (addition), complement (complement), or substitution (substitute) for learning activities in the classroom that have been this is used. [34].

2. RESEARCH METHODS

This research is an experimental research. The research subjects were divided into two groups, namely the modelling group and the implementation group. This research was conducted in the second semester of the 2019/2020 school year for 2 months, from March 2020 to May 2020. This research was conducted in MAN 3 Sleman. The subject of this limited trial research was 31 students of class X in MAN 3 Sleman. Sampling using purposive sampling with certain considerations by knowing the conditions or situations under study [35].

The instruments in this study are a) Learning Instruments, namely Student Worksheets (Worksheet) and b) Research instrument, namely Problem-Solving Ability Sheet. The analysis technique carried out in the study used several techniques, namely the sign test and descriptive analysis.

2.1. Analysis of Problem-Solving Ability Sheet

The achievement of problem-solving abilities is seen from the scores obtained through tests using 2 tests, namely the pre-test and post-test then it will be calculated using the calculation of the sign test using the SPSS program.

2.2. Inferential analysis

This analysis was carried out to prove the truth of the provisional conjecture (hypothesis) in this study. The hypotheses in this study are:

Ho: there is no increase in the average score of students' problem-solving abilities when using E-learning Worksheet.

Ha: there is an increase in the average value of students' problem-solving abilities when using E-learning Worksheet.

This assumption is based on the significance level $\alpha = 0.05$. If later a significance value is obtained <than α , it can be stated that Ho is rejected and Ha is accepted which means that there are differences in problem-solving abilities between students who use

Worksheet E-learning (treatment class) and the problem-solving abilities of students who use printed Worksheet (class without treatment) and otherwise

3. RESULTS AND DISCUSSION

Modelling class carried out measurements of students' problem-solving abilities using E-Learning Worksheet and using conventional learning. Data analysis using descriptive analysis techniques. The measurement of problem-solving abilities aims to test the improvement of the developed Worksheet. The following is an analysis of the modelling class in which the class using the Worksheet has been developed. The mean pre-test score was 7.74 while the average post-test score was 98.68 which indicates an increase. But to be surer of the data analysis using the sign test analysis, based on the data obtained that, there is 1 student whose post-test score is smaller than the pre-test. A total of 23 students had a high post-test score than the pre-test, and 2 students had the same post-test and pre-test scores. Based on the statistical test using the sign test, it was obtained an alpha of 0.003. Because $\alpha < 0.05$, H_0 is rejected, so that there is an increase in problem solving ability using Worksheet that has been used in the modelling class.

The following is an analysis of the implementation class, where the class uses the developed Worksheet. Analysis using the SPSS program, in order to obtain various data, the average pre-test score was 8.26 while the average post-test score was 9.19 which indicates an increase. But to be surer of the data analysis using the sign test analysis, based on the data obtained that, there is 1 student whose post-test score is smaller than the pre-test. A total of 27 students had a high post-test score than the pre-test, and 2 students had the same post-test and pre-test scores. The results of statistical tests using the sign test obtained an alpha of 0.001. Because $\alpha < 0.05$, H_0 is rejected, so that there is an increase in problem solving ability using Worksheet that has been used in the implementation class.

The use of media applied by the researcher was in the modelling class, while for the implementation class, the teacher applied it in a different class. The results of the modelling and implementation classes experienced a higher problem-solving increase in the modelling class after learning with Worksheet E-Learning. The developed Worksheet media provides an understanding of problem solving to students, this is in terms of the post-test scores of the two classes which increase after being given learning using the developed Worksheet. Student learning activities are better with learning by applying a problem-solving process so that the scores from both classes produce

good improvement scores. In accordance with [36], learning using problem-solving models can increase learning activities.

Although the students' average scores in the modelling class and the implementation class both increased, by explaining when they answered the questions, the researcher knew that students understood the concept of physics, not only understanding mathematical concepts. Thus, according to the researcher, the modelling class students' answers were better than the implementation class students, this was because the modelling class scores were better. Learning physics is not just counting or understanding mathematical concepts but students must be able to interpret the meaning of physics in the problem of every event that will make it easier for students to learn physics [37].

The material on impulse momentum explains a lot about problems in everyday life, so learning using problem-solving models on impulse momentum material is an alternative to teaching. Learning problem solving requires innovation and creativity so that the context is made easy to convey [38].

4. CONCLUSION

Based on the results and discussion of this study, it can be concluded that there is an increase in the problem-solving ability of using Worksheet that has been developed in the modelling class and the implementation class of MAN 3 Sleman in class X. E-learning learner's worksheets effectively improve problem solving for momentum and impulse material. Learning problem solving will be better if there is creativity from the teacher during learning. The increase occurred in the ability to solve a physics problem coherently starting from the formula used, mathematical solving to concluding the results of the calculations that have been completed.

REFERENCES

- [1] L.M Kennedy, S. Tipps, A. Johnson, Guiding Children's Learning of Mathematics, Thomson Wadsworth, 2008
- [2] A.S. Posamentier, S. Krulik, Problem Solving in Mathematics Grades 3–6, Powerful Strategies to Deepen Understanding, Thousand Oaks: Corwin, 2009
- [3] D.H. Jonassen, Learning to Solve Problems An Instructional Design Guide, Pfeiffer, 2004
- [4] J. Surif, N.H. Ibrahim, M. Mokhtar, Conceptual knowledge and procedural knowledge in problem solving, in: *Procedia-Social and Behavioral Sciences*, vol. 56, Elsevier, Amsterdam, 2012, pp. 416-425 DOI: <https://doi.org/10.1016/j.sbspro.2012.09.671>
- [5] S. Temel, The Effects of Problem-Based Learning on Pre-Service Teachers Critical Thinking Dispositions and Perceptions of Problem-Solving Ability, *South African Journal of Education* 34(1) (2014) 1-20. DOI: <https://doi.org/10.15700/201412120936>
- [6] S. Khan, A.D.I. Hafeez, M. Saeed, The Impact of Problem-Solving Skill of Heads' on Students' Academic Achievement, *Interdisciplinary Journal of Contemporary Research in Business* 4(1) (2012) 316-330.
- [7] J.M. Kizilirmak, B. Wiegmann, A.R. Klavehn, Problem Solving as An Encoding Task: A Special Case of The Generation Effect, *The Journal of Problem Solving* 9(1) (2016) 59-76. DOI: <http://doi.org/10.7771/1932-6246.1182>
- [8] Schunk, H. Dale, *Learning Theories: An Educational Perspectives*, Pearson Education Inc, 2012
- [9] G. Polya, *Mathematical Discovery: On Understanding, Learning and Teaching Problem Solving*, John Willey & Sons, Inc, 1981
- [10] J.L. Docktor, N.E. Strand, J.P. Mestre, B.H. Ross, Conceptual problem solving in high school physics, *Physical Review Special Topics - Physics Education Research* 11(2) (2015) 1-13. DOI: <https://doi.org/10.1103/PhysRevSTPER.11.020106>
- [11] B. Koichu, U. Leron, Proving as Problem Solving: The Role of Cognitive Decoupling, *The Journal of Mathematical Behavior* 40 (2015) 233-244. DOI: <https://doi.org/10.1016/j.jmathb.2015.10.005>
- [12] T.S. Sumartini, Peningkatan Kemampuan Pemecahan Masalah Matematis Siswa Melalui Pembelajaran Berbasis Masalah. *MOSHARAF: Jurnal Pendidikan Matematika* 5(2) (2016) 148-158. DOI: <https://doi.org/10.31980/mosharafa.v5i2.270>
- [13] Sugiarti. Pembelajaran Fisika Berbantuan Simulasi PhET dalam Membangun Konsep Siswa. *Wahana Didaktika Jurnal Ilmu Kependidikan* 13(1) (2015) 126-135. DOI:

- <http://dx.doi.org/10.31851/wahanadidaktika.v13i1.285>
- [14] E. Kim, S. Pak, Students Do Not Overcome Conceptual Difficulties After Solving 1000 Traditional Problems, *American Journal of Physics* 70(7) (2002) 759-765 DOI: <https://doi.org/10.1119/1.1484151>
- [15] S. Bayat, A. Meamar, Predicting algebra achievement: Cognitive and metacognitive, in: *Procedia Social and Behavioral Science*, vol. 217, Elsevier, Amsterdam, 2016, pp. 169-176, DOI: <https://doi.org/10.1016/j.sbspro.2016.02.054>
- [16] P. Zeitz, *The Art and Craft of Problem Solving*, John Wiley & Sons, Inc, 2007
- [17] G. Lazakidou, S. Retalis, Using Computer Supported Collaborative Learning Strategies for Helping Students Acquire Self-Regulated Problem-Solving Skills in Mathematics, *Computers & Education* 54(1) (2010) 3-13 DOI: <https://doi.org/10.1016/j.compedu.2009.02.020>
- [18] S. Selmer, U. Kale, Teaching Mathematics Through Problem Solving, *Innovacion Educativa* 13(62) (2013) 45-60.
- [19] J.L. Docktor, J.P. Mestre, Synthesis of Discipline-Based Education Research in Physics, *Physical Review Special Topics-Physics Education Research* 10(2) (2014) 1-58 DOI: <https://doi.org/10.1103/PhysRevSTPER.10.020119>
- [20] J.L. Docktor, N.E. Strand, J.P. Mestre, B.H. Ross, Conceptual problem solving in high school physics, *Physical Review Special Topics-Physics Education Research* 11(2) (2015) 1-13. DOI: <https://doi.org/10.1103/PhysRevSTPER.11.020106>
- [21] A.M. Saifullah, Sutopo, H. Widodo, Senior High School Students' Difficulties in Solving Impulse and Momentum Problems, *Jurnal Pendidikan IPA Indonesia* 6(1) (2017) 1-10. DOI: <https://doi.org/10.15294/jpii.v6i1.9593>
- [22] L.S. Tan, S.S. Lee, L.D. Ponnusamy, E.R. Koh, K.C.K. Tan, Fostering Creativity in The Classroom for High Ability Students: Context Does Matter, *Education Sciences* 6(4) (2016) 36-53. DOI: <https://doi.org/10.3390/educsci6040036>
- [23] M.M. Hudha, S.D. Aji, A. Permatasari, R.D. Purnama, Authentic Problem Based Learning (APBL) untuk Meningkatkan Kemampuan Berpikir Siswa, *Jurnal Pendidikan Matematika dan IPA* 8(1) (2017) 64-70. DOI: <http://dx.doi.org/10.26418/jpmipa.v8i1.18425>
- [24] A.L. Yuberti, A. Anugrah, A. Seregar, Misbah, K. Jermsttiparsert, Approaching Problem-Solving Skills of Momentum and Impulse Phenomena Using Context and Problem-Based Learning, *European Journal of Educational Research* 8(4) (2019) 1217-1227. DOI: <https://doi.org/10.12973/eu-jer.8.4.1217>
- [25] E.R. Savelsbergh, T. de Jong, M.G.M. Ferguson-Hessler, Choosing The Right Solution Approach: The Crucial Role of Situational Knowledge in Electricity and Magnetism, *Physical Review Special Topics - Physics Education Research* 7(1) (2011) 1-12. DOI: (<http://dx.doi.org/10.1103/PhysRevSTPER.7.010103>)
- [26] P.D. Brok, R. Taconis, D. Fisher, How well Do Science Teacher Do? Differences in Teacher-Student Interpersonal Behaviour Between Science Teachers and Teachers of Other (School) Subjects, *The Open Education Journal* 3(1) (2010) 44-53. DOI: <http://dx.doi.org/10.2174/1874920801003010044>
- [27] J.A. Ikhwanuddin, D. Purwantoro, Problem Solving dalam Pembelajaran Fisika untuk Meningkatkan Kemampuan Mahasiswa Berpikir Analitis, *Jurnal Kependidikan* 40(2) (2010) 215-230. DOI: <https://doi.org/10.21831/jk.v40i2.500>
- [28] Azizah, Rismatul, Yuliati, Lia, Latifah, Eny, Kesulitan Pemecahan Masalah Fisika pada Siswa SMA, *Jurnal Penelitian Fisika dan Aplikasinya* 5(2) (2015) 44-50. DOI: <http://dx.doi.org/10.26740/jpfa.v5n2.p44-50>
- [29] N. Hamidah, S. Haryani, S. Wardani, Efektivitas Lembar Kerja Peserta Didik Berbasis Inkuri Terbimbing untuk Meningkatkan Hasil Belajar Siswa, *Jurnal Inovasi Pendidikan Kimia* 12(2) (2018) 2212-2223.
- [30] Ministry of Education, Teaching Material Development, Language Development and Development Agency of the Ministry of Education and Culture, 2008.

- [31] J. Simangunsong, J. Sinuraya, Uji Kelayakan Lembar Kegiatan Peserta Didik (LKPD) Berbasis Inkuiri Terbimbing Kelas X Materi Pokok Momentum, Impuls dan Tumbukan, *Jurnal Ikatan Alumni Fisika Universitas Negeri Medan* 5(4) (2019) 23-27. DOI: <https://doi.org/10.24114/jiaf.v5i4.15350>
- [32] A. Prastowo, *Qualitative Research Methods in Research Design Perspective*, Ar- Ruzz Media, 2011
- [33] N. Hidayati, Sistem E-Learning untuk Meningkatkan Proses Belajar Mengajar: Studi Kasus pada SMA Negeri 10 Bandar Lampung, *Jurnal Telematika MKOM*, 2(2) (2010) 153-170.
- [34] N.W.M.A. Putri, I.N. Jampel, I.K. Suartama, Pengembangan E-Learning Berbasis Schoology Pada Mata Pelajaran IPA Kelas VII di SMP Negeri 1 Seririt, *Jurnal EDUTECH Undiksha* 2(1) (2014). DOI: <https://dx.doi.org/10.23887/jeu.v2i1.3796>
- [35] Sugiyono, *Quantitative Research Methods and R&D*, Alfabeta, 2012
- [36] S.F. Setiyawati, H. Kuswanto, Pengembangan Buku Pedoman Guru pada Pembelajaran Fisika SMA Menggunakan Model Problem Solving Level Inkuiri, *Jurnal Inovasi Pendidikan IPA* 1(2) (2015) 225-236. DOI: <https://doi.org/10.21831/jipi.v1i2.7509>
- [37] Irwansyah, Sukarmin, Harjana, Development of Three-Tier Diagnostics Instruments on Student's Misconception Test in Fluid Concept, *Jurnal Ilmiah Pendidikan Fisika Al-BiRuNi* 7(2) (2018) 207-217. DOI: <https://doi.org/10.24042/jipfalbiruni.v7i2.2703>
- [38] Yuberti, S. Latifah, A. Anugrah, A. Saregar, Misbah, K. Jermsttiparsert, Approaching Problem-Solving Skills of Momentum and Impulse Phenomena Using Context and Problem-Based Learning, *European Journal of Educational Research* 8(4) (2019) 1217-1227. DOI: <https://doi.org/10.12973/eu-jer.8.4.1217>