

The application of physics e-handout assisted by PBL model use Edmodo to improve critical thinking skills and ICT literacy of high school students

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Abstract. This study aims to improve students' critical thinking skills and ICT literacy physics using e-handouts assisted by the PBL model using Edmodo material on the Law of Conservation of Momentum and Collision. This type of research is pre-experimental design with one group pretest-posttest design. This study students who participated were class X MIA 1 and X MIA 3 SMA Negeri 1 Sleman with the same treatment. The sample consisted of two classes, each class totaling 30 students. The sample taken is a cluster random sampling technique. Retrieval of data from the results of the pretest and posttest for critical thinking skills, while observation to determine the ICT literacy of students in both classes. The result is that through e-handout assisted by PBL models using Edmodo students can improve critical thinking skills. The application of e-handout assisted by the PBL model using Edmodo to the ICT literacy of students is good enough.

Keywords: *e-handout, PBL (Problem Based Learning) model, Edmodo, critical thinking skills; ICT literacy*

1. Introduction

Revolution 4.0 brings changes to education known as education 4.0 which can produce educational innovations for the future. Education including the needs of this revolution that combines technology and also humans in learning [1]. In line with this revolution, learning requires thinking skills to be able to solve problems and face the challenges of globalization.

The requirements of this era apply lessons that train students to think and integrate actions to grow critical thinking skills in the classroom [2] recognized as important skills in the 21st century. These skills are considered as a set of skills needed by students in dealing with global problems that include the ability applying information technology, digital capabilities [3], communication, collaboration, and critical thinking [4].

Critical thinking skills become the needs of students to solve problems encountered in everyday life. The skills are still low in high school physics learning [5]. When faced with physics problems, students will find it difficult to understand questions and solve problems [6]. The teacher must practice the students' critical thinking skills by applying learning that equips students to produce an effective learning process. The learning model that can train students to think critically is Problem Based Learning (PBL) [7].



PBL can build students' knowledge personally [8]. PBL can stimulate students to be motivated to learn and think critically so that it will have an impact on improving their learning achievement [9]. PBL is very relevant in this 21st-century where students are required to be more active as well as independent learning exercises [10] to investigate real problems. PBL is suitable to be integrated with learning media in the form of technology. PBL is applied by learning ICT (information, communication, and technology) to help improve students' critical thinking skills [11]. The utilization of ICT is one of the opportunities and challenges of teachers in building meaningful and enjoyable learning [12]. Because the main key technology of 21-st century learning [13].

Studying in science currently lacks effective use of technology in schools especially physics. Even though ICT literacy is important for students [14]. The results of observations of learning in class X SMAN 1 Sleman shows learning activities have not actively involved students and the facilities provided such as LCD projectors are underutilized for learning. Though technology can be used for the learning process because the school has fulfilled its facilities such as LCD and internet access. A media or teaching material that supports technology-based learning is needed.

The learning alternative uses e-handouts. This e-handout is expected to help facilitate student learning. The complexity of teaching materials makes students more difficult and less interested in reading textbooks including physics books. Handouts usually contain brief material. Teachers and students will get ease in carrying out learning activities using handouts. Handouts will guide the teacher in regular and clear learning [15]. In this teaching material combined with electronic media in the form of e-handouts using Edmodo.

Edmodo as social networking has a positive effect on student learning in general [16]. Edmodo provides an opportunity for teachers to monitor student development, share material and communicate with their students [17] who utilize ICT learning. The use of Edmodo greatly motivates students and strongly supports the work of teachers [18]. Edmodo can be used as additional media. The teacher can put all materials on Edmodo and students can access them before starting class or at home [19].

E-handout with the help of the PBL model using Edmodo is expected that students understand Physics material well so that they can think critically and learner ICT literacy.

2. Research method

The subject of this research is class X SMA Negeri 1 Sleman. Researching in April even semester of 2018/2019 school year. Sampling in this study using cluster random sampling. Class X MIA 1 as a pilot class taught by researchers and Class X MIA 3 as an implementation class taught by the teacher. Both classes were carried out with the same treatment, namely applying e-handout assisted by the PBL model using Edmodo. Each class consists of 30 students for the pilot class and the implementation class. Research with pre-experimental design using one group pretest-posttest design.

Retrieval of data using tests and observations. A description test to determine the improvement of students' physics critical thinking skills in the material of the Law of Conservation of Momentum and Collision during the pretest and posttest. This description test is based on indicators of critical thinking skills. The pretest and posttest results were analyzed to find out the N-gain. The N-gain formula [20] is:

$$g = \frac{S_{\text{post}} - S_{\text{pre}}}{S_{\text{maks}} - S_{\text{pre}}} \quad (1)$$

The N-gain comparison of critical thinking between the pilot class and the implementation class was tested using a two-statistical difference test (t-test) through SPSS 20. The observation sheet was used to look at the ICT literacy of students adjusted to aspects of ICT literacy. This sheet is used during the learning process, especially when implementing e-handouts assisted by the PBL model using Edmodo. The observation sheet is used to see the ICT literacy of students by aspects of ICT literacy in each indicator. The ICT literacy criteria of students are based on the values obtained with the provisions in table 1.

Table 1.Assesment category.

Interval (%)	Category
76 - 100	Good
56 - 75	Enough
40 - 55	Deficient
< 40	Bad

3. Result and Discussion

3.1. Description of students' critical thinking skills

The value of students' critical thinking abilities in physics is obtained through the results of the test breakdown in the pilot class and the implementation class with the same treatment that is implementing e-handouts aided by the PBL model using Edmodo. This description test is done to get the pretest and posttest data. The results of students' critical thinking abilities in physics are shown in figure 1.

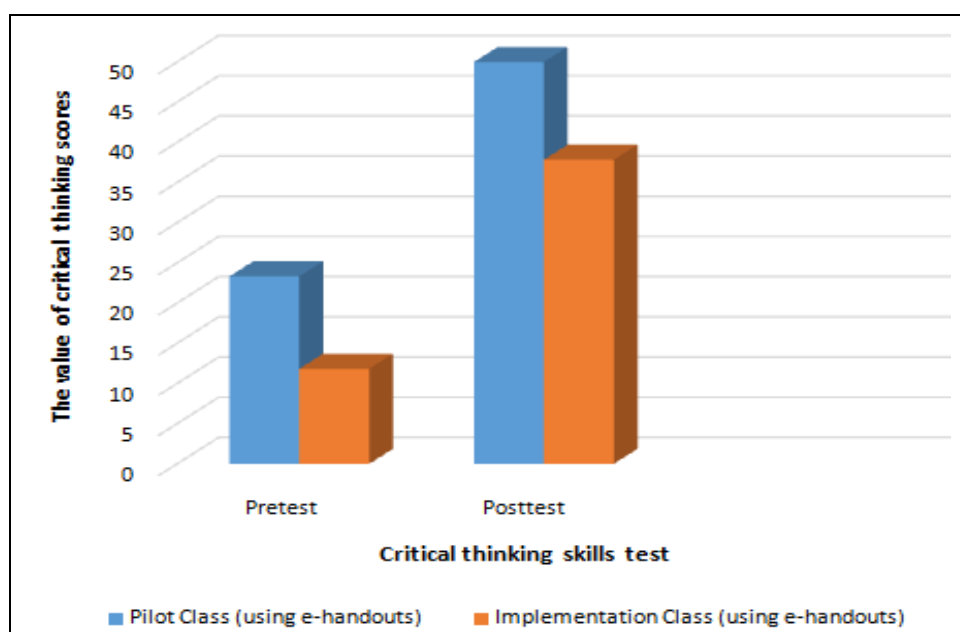


Figure 1. Comparison diagram of the value of critical thinking skills.

The average score of the pilot class and the class of data analysis implementation of the results of the pretest of students' critical thinking skills is relatively low before the application of Edmodo-assisted e-handouts with PBL models. This is caused by a test to measure the students' initial ability in the pilot class and the implementation class on material that has not been taught before. After being given treatment to both groups through the application of the same learning only different teachers, then given a posttest.

Analysis of the study using the Paired Sample t-test Test Statics for the pilot class obtained an average of 23.33 pretest results and for an average posttest result of 50.00. As for the implementation class, the average pretest result is 11.83 and the average posttest result is 37.83. The results of the study average pretest and posttest scores for the pilot class of 26.67% and for the implementation class of 26% obtained an increase in students' critical thinking skills.

The average value of the results of critical thinking skills in the pilot class obtained a pretest value of 23.33 < 50.00 posttest value. While the average value of the implementation class obtained pretest value 11.83 < 37.83 posttest value. Descriptively there are differences in the average results of critical thinking skills on the pretest and posttest scores.

Comparison of the value of N-gain (in percent) in the pilot class and the implementation class is shown in figure 2.

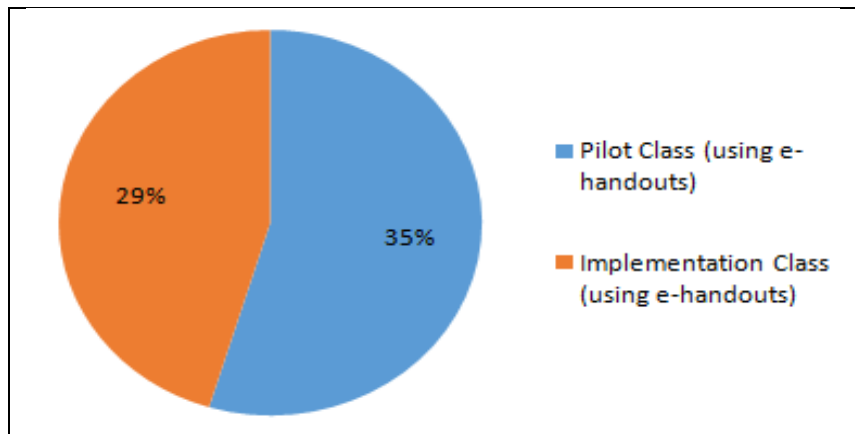


Figure 2. Data diagram comparing N-gain scores.

Comparison of normalized average gain values in the pilot class with the implementation class. The results of data analysis revealed that the N-gain scores of the two classes were not satisfactory. This is caused by the influence of different student characteristics from the two classes, as well as the effect of differences in teaching. The N-gain score for the average value of the pilot class is 0.35 in the medium category, while the N-gain for the implementation class is 0.29 in the low category. However, the results of the research there are improvements that can be seen from the pretest and posttest scores of both classes.

The results of the SPSS paired samples correlation test for the pilot class obtained a correlation coefficient of 0.613 with a significance (Sig.) 0.00. Because the value of sig. 0.00 < probability 0.05 then there is a relationship of the variable pretest and posttest values. While for the implementation class the correlation coefficient is 0.526 with a significance (Sig.) 0.003. Because the value of sig. 0.003 < probability 0.05, then there is a relationship of the pretest and posttest value variables. From the Paired Sample T Test output table in the pilot class and the implementation class the Sig. (2-tailed) is 0.000 < 0.05 so H_0 is rejected and H_a is accepted. The pilot class of $t_{\text{count}} > t_{\text{table}}$ is $10.449 > 2.045$ and the implementation class of $t_{\text{count}} > t_{\text{table}}$ is $9.425 > 2.045$. It was concluded that there were differences in the average results of critical thinking skills, which means that there was an influence on the use of e-handouts assisted by the PBL model using edmodo in improving students' critical thinking skills on the Material of Conservation of Momentum and Collision Laws of Class X SMAN 1 Sleman.

The implementation of technology in learning can improve basic skills in 21st century learning, such as critical thinking [21]. Learners find difficulty when they are trying to solve questions [22]. Most students have difficulty in solving the Momentum and Collision problem. This is because students fail to activate concepts that are relevant to the problem. Failure to solve a problem causes low student learning.

Research shows that learning physics is determined based on critical thinking skills using edmodo has good quality criteria. Learning tools developed can be used and reliably. This skill has a significant increase (N-gain score) that is 0.6 in the medium category, and the results of students' responses to positive learning [23]. Other research also shows that the PBL model can improve learning achievement and also students' critical thinking skills [24]. There is a positive effect on students' learning achievement and critical thinking by applying the PBL model in learning (N-gain score) which is 0.49 from the experimental group.

3.2. Description of ICT literacy of students

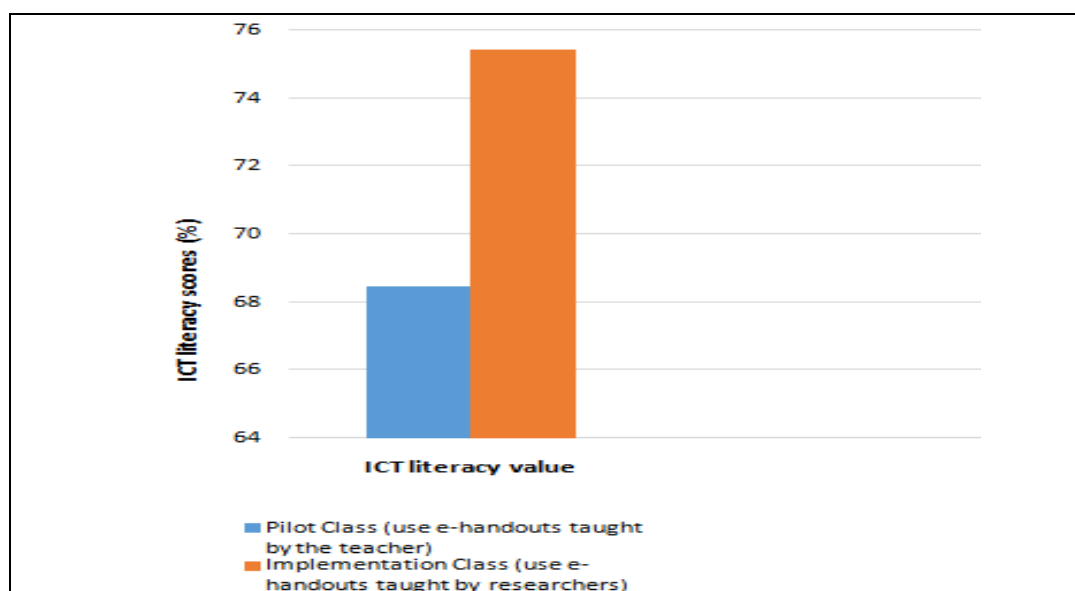
Research that has been conducted in the pilot class and the implementation class obtained the results of the ICT literacy aspects of students in table 2.

Table 2. Aspects of ICT literacy in students.

ICT literacy aspects	Pilot class (%)	Category	Implementation class (%)	Category
Access	78.60	Good	75.00	Enough
Manage	66.70	Enough	72.50	Enough
Integrate	69.40	Enough	76.70	Good
Evaluate	67.80	Enough	78.30	Good
Make / Create	65	Enough	77	Good
Communicating	63.30	Enough	73.30	Enough

Percentage of ICT literacy aspects for the pilot class and implementation class using e-handout assisted by the PBL model using Edmodo in the first aspect, namely accessing 78.6% in the good category and 75% in the pretty good category. The second aspect is managing/processing at 66.7% and 72.5% in the category quite well. In the third aspect, integrating 69.4% in the good enough category and 76.7% in the good category. While in the fourth aspect, evaluating, for the pilot class of 67.8% the category is quite good and for the implementation class by 78.3% in the good category. The fifth aspect is making/creating 65% of the good enough category and 76.7% in the good category. The communicating aspect is 63.3% and 73.3%, which is quite good.

The results of the percentage of aspects of ICT literacy per indicator can be obtained the value of all ICT literacy indicators for the pilot class at 68.47% while for the implementation class at 75.42%. Pilot classes are classes taught using e-handouts by researchers. While the implementation class is a class taught using e-handouts by the teacher. ICT literacy assessment is categorized quite well with a range of 56% - 75%. The average value of the two classes between the pilot class and the implementation class was 71.95 so it can be said that the indicators of ICT literacy in the criteria are quite good. The results of ICT physics literacy scores of students are shown in figure 3.

**Figure 3.** Comparison diagram of ICT literacy values.

The results of subsequent studies determine the difference between the average value of ICT literacy of students in the pilot class and the implementation class. Analysis of the significance of the average ICT literacy results of students is shown in table 3.

Table 3. Analysis of differences in the mean value of ICT literacy.

Analysis	Class	ICT Literacy
Normality	Pilot	0.167
	Implementation	0.705
Homogeneity		0.243 > 0.05
Hypothesis testing		Sig. (2-tailed) 0.015 < 0.05

The normality test using the SPSS 20 program based on Shapiro-Wilk normality test outputs is known as Sig values. for the pilot class of 0.167 and the Sig. for the implementation class of 0.705. Because of the value of Sig. for both classes > 0.05, the ICT literacy results of students for the pilot class and the implementation class are normally distributed. Then the homogeneity test is performed and the Sig. 0.243 > 0.05. So it can be concluded that the variance of data on the results of ICT physics literacy in the pilot class and class implementation students is homogeneous or the same. Thus, one of the conditions (not absolute) of the independent sample t-test can be fulfilled.

The test continues with the Independent Sample Test to test the hypothesis. The Independent Sample Test value in the Equal variances assumed section is known by Sig. (2-tailed) of 0.015 < 0.05, it was concluded that H_0 was rejected and H_a was accepted. Thus it can be concluded that there is a significant difference between the average results of ICT Literacy of students in the pilot class and the implementation class.

Education has the strongest influence on ICT integration. ICT literacy is referred to as one of the skills needed to be successful in the 21-st century [24]. ICT literacy is the ability of digital literacy or information and communication technology that aims to build students' knowledge related to processing an information source.

In line with these studies show that the developed learning tools can equip students' foundational knowledge specifically on digital/ICT literacy with excellent criteria and can facilitate students to improve scientific literacy as indicated by t-tests that are sig > 0.005[25].

4. Conclusion

The results of this study can be concluded that the application of e-handout assisted by PBL models using Edmodo can improve the critical thinking skills of students of class X MIA SMAN 1 Sleman. This ability improvement is obtained by the students' pretest and posttest scores. The application of e-handout assisted by the PBL model using Edmodo to ICT literacy of students in class X MIA SMAN 1 Sleman is quite good. Further research, not only critical thinking skills and ICT literacy but also other 21-st century skills.

References

- [1] Hussin A 2018 *International Journal of Education & Literacy Studies* **6** 3
<https://doi.org/10.7575/aiac.ijels.v.6n.3p.92>
- [2] Syarkowi A 2018 *Proc. 4th International Seminar Mathematics, Science and Computer Science Education (Bandung)* vol 1013 (Bristol: IOP Publishing) p 1-5
<https://doi.org/10.1088/1742-6596/1013/012078>
- [3] Susilawati S, Ristanto N and Khoiri 2015 *Jurnal Pendidikan Fisika Indonesia* **11** 73–83
<https://doi.org/10.15294/jpfi.v11i1.4005>
- [4] Sanabria J C and Jesús A L 2017 *Eurasia Journal of Mathematics, Science and Technology Education* **13** 487–501
<https://doi.org/10.12973/eurasia.2017.00627a>
- [5] Puspita I, Kaniawati I and Suwarma I R 2017 *Proc. International Conference on Mathematics and Natural Sciences (IconMNS 2017) (Bali)* vol 895 (Bristol: IOP Publishing) p 1-4
<http://doi.org/10.1088/1742-6596/895/1/012100>
- [6] Adams W K and Wieman C E 2015 *American Journal of Physics* **83** 459–67
<https://doi.org/10.1119/1.4913923>
- [7] Yuliati L, Fauziah R, and Hidayat A 2018 *Proc. 4th International Seminar Mathematics, Science*

- and Computer Science Education (Bandung) vol 1013 (Bristol: IOP Publishing) p 1-7
<http://doi.org/10.1088/1742-6596/1013/1/012025>
- [8] Shabrina and Kuswanto H 2018 *Int. J. Instr* **11** 4 <https://doi.org/10.12973/iji.2018.11419a>
 - [9] Triyuni 2016 *J. Inov. Pendidik. IPA* **5** 177–85 <https://doi.org/10.15294/jpii.v5i2.7679>
 - [10] Argaw A S, Haile B B, Ayalew B T and Kuma S G 2017 *EURASIA Journal of Mathematics Science and Technology Education* **13** 857–71 <https://doi.org/10.12973/eurasia.2017.00647a>
 - [11] Nirbita B N, Joyoatmojo S and Sudiyanto 2018 *International Journal of Multicultural and Multireligious Understanding* **5** 341–48 <https://doi.org/10.18415/ijmmu.v5i4.295>
 - [12] Patmanthara S and Hidayat W N 2018 *2nd International Conference on Statistics, Mathematics, Teaching, and Research (Makasar)* vol 1028 (Bristol: IOP Publishing) p 1-7
<http://doi.org/10.1088/1742-6596/1028/1/012076>
 - [13] Garba S A, Yusuf B and Busthami A H 2015 *International Journal of Emerging Technologies in Learning* **10** 72-9 <https://doi.org/10.3991/ijet.v10i4.4717>
 - [14] Eliana E D S, Senam, Wilujeng I and Jumadi 2016 *J. Pendidikan IPA indones.* **5** 51-5
<https://doi.org/10.15294/jpii.v5i1.5789>
 - [15] Koswara A and Mundilarto 2018 *J. Inov. Pendidik. IPA* **4** 11-25.
<https://doi.org/10.21831/jipi.v4i1.6193>
 - [16] Dere E, Yücel Ü A, and Yalçınalp S 2016 *Elementary Education Online* **15** 804-19
<https://doi.org/10.17051/eeo.2016.49794>
 - [17] Ma'azi H and Janfeshan K 2018 *Cogent Education* **5**
<https://doi.org/10.1080/2331186X.2018.1536312>
 - [18] Batsila M, Tsihouridis, and Vavougiou D 2014 *International Journal of Emerging Technologies in Learning* **53** <https://doi.org/10.3991/ijet.v9i1.3018>
 - [19] Vania P F, Setiawan W and Wijaya A F C 2018 *Journal of Science Learning* **1** 110-15
<https://doi.org/10.17509/jsl.v1i3.11796>
 - [20] Hake Rr 2007 *Handbook of Design Research Methods in Mathematics, Science, and Technology Education* 1–24 <https://doi.org/10.4324/9781315759593-42>
 - [21] Muawiyah D, Yamtinah S and Indriyanti N Y 2018 *Proc. International Conference on Research, Implementation and Education of Mathematics and Science (Sleman)* vol 1097 (Bristol: IOP Publishing) p 1-7 <https://doi.org/10.1088/1742-6596/1097/1/012058>
 - [22] Saifullah A M, Sutopo and Wisodo H *J. Pendidikan IPA indones.* **6** 1-10
<https://doi.org/10.15294/jpii.v6i1.9593>
 - [23] Mundilarto and Ismoyo H 2017 *Journal of Baltic Science Education* **16** 761–79
 - [24] Zainudin and Pambudi B 2019 *Jurnal Pendidikan Fisika Indonesia* **15** 14-23
<https://doi.org/10.15294/jpfi.v15i1.14350>
 - [25] Muskania R T and Wilujeng I 2017 *Cakrawala Pendidikan* **36** 1
<https://doi.org/10.21831/cp.v36i1.8830>