Animation-based Learning Effectiveness in Physics Learning

Arif Rahman Aththibby1,2*, Mundilarto2, Widodo3

1Universitas Muhammadiyah Metro, Kota Metro, Lampung, Indonesia
2Universitas Negeri Yogyakarta, Yogyakarta, Indonesia
3Universitas Ahmad Dahlan, Yogyakarta, Indonesia

*arifahthibby@gmail.com

Abstract. 21st century education requires teachers who can adapt to technological developments, including for physics teachers. Physics as one of the branches of science, studying and analyzing quantitatively the symptoms or natural processes. Physics is a science that studies the parts of nature and the interactions within them. The problem that is always experienced by students is the low learning outcomes caused by the lack of motivation in learning physics. Computer animation can be a solution offered to present effective learning in physics learning. Based on the results of the study it is known that the use of computer animation has a significant effect on the learning outcomes of physics and also the motivation of students in learning physics.

1. Introduction
The educational paradigm shift from instructive philosophy to constructivist causes a shift in the need for education. This can be seen from the current education known as 21st century education. Teachers encourage to use advanced technology in accordance with pedagogical work agreements that support learning material [1]. However, education in the 21st century is not easily realized. This is related to the challenges that exist in our education. The first obstacle is the challenge of innovation in science learning. The second obstacle is class and school connectivity. The third obstacle is the expectation between different teachers and students. Four barriers are changes in class management [2].

A key aspect of education carried out by science teachers is the ability to teach students. This is related to how to communicate science concepts to students. This can be difficult, because many of the concepts underlying the explanation of the scientific process cannot be easily observed by students [3]. A part of science is physics. Physics as one of the branches of science, studying and analyzing quantitatively the symptoms or natural processes. Physics is a science that studies the parts of nature and the interactions within them [4].

One of the problems faced today is that the results of student physics learning in Indonesia also continue to decline, as seen from the national exam scores which from 2015 to 2018 continue to decline. This was allegedly caused by the lack of motivation of students in learning physics. Motivation is an important part of producing good academic ability for students [5]. Motivational problems in physics learning experienced by students while at the High School level impact on the ability to learn physics which becomes even more difficult for them in college [6].

TPACK in 21st century learning presents technology as a potential solution in reducing educational problems commonly encountered in educational activities. In order for the use of technology to run

Published under licence by IOP Publishing Ltd
optimally in learning activities, it is necessary to modify the use of technology by taking into account local conditions. Educators need to emphasize that what is more important is that learning activities do not lie in the mastery of computer technology but in their educational practices. The practice of education developed by integration or by the use of computer technology used by educators must be in accordance with the context of the class and curriculum, and most importantly how students learn science with computer technology rather than just focusing on using computer mastery techniques [7].

Implementation of the use of technology in the world of education used by educators must be in accordance with the class and curriculum, and the most important is the way students learn with computer technology that is only in accordance with the use of computer mastery techniques [8]. Some physics instruction of promising strategies have already been successfully explored, such as visual animations for communicated environment, to help students achieve more effective physics learning [9], it caused along with the advancement of computational technology, the representations of the interaction of various physical quantities in a phenomenon can be presented in dynamic formats in the form of animations and simulations. The focus of this study was to determine the effectiveness of the use of computer animation in solving problems of learning outcomes and motivation on physics learning.

2. Methods

This research was conducted in the state senior high school 1 Bantul, Yogyakarta. This study uses quasi experimental method using Posttest Only Design, can be seen in table 1.

| Group           | Treatment | Postest |
|-----------------|-----------|---------|
| Control Class   | Xa        | T       |
| Treatment Class | Xb        | T       |

Explanations:
Xa : Learning without using computer animation
Xb : Computer animation used in learning process
T : Test [10].

Treatment class is a group with which learning is given treatment by using learning tools of development outcomes. The control class is a class that is learning by using the medium of instruction in high school. After the treatment is completed, the students in the treatment class and control class are given the final test to know the achievement of student learning outcomes and questionnaires to find out the students' responses to the learning. Treatment process requires three meetings. The first meeting is the delivery of business material and power. The second meeting contains energy material and the third meeting is done posttest to find out the learning outcomes and student motivation after learning.

3. Results and Discussion

The effectiveness of using computer animation in learning physics will be seen from its effect on learning outcomes and student motivation in learning physics. The results of the use of computer animation media in learning were the value of physics subjects in the experimental group was 72.7 with 52% learning completeness. This result is better than the value obtained by the control group, which is 64.5 with a learning completeness level of 13.3%. Furthermore, To know the effectiveness of the application of learning media in the form of animation to learning outcomes and motivation of students learning using multivariate analysis of two-way MANOVA with with SPSS 16 program. This analysis is used because this research variable consists of one independent variable that is learning media and two variables bound that is learning outcomes and motivation in physics learning.

Test conducted to determine the effectiveness of the use of media used the normality test, assay homogeneity test, multivariate test, and Hypothesis test. Normality test used is kolmogorov-smirnov test. The result of data analysis on learning result variable has significance value 0.731> 0.05 hence data stated normal distribution and data on motivation variable have significance value 0.374> 0.05.
then data stated normal distribution. Homogeneity test consists of covariance test (Box’s test). From the results it is known that the significance of the covariance test is 0.252 because the significance value is more than 0.05 (0.252 > 0.05) then H₀ is accepted. So it can be concluded that the covariant data is the same so that the covariance assumption is fulfilled. Furthermore, the variant test was performed by Levene's test with the same data group assumption. The result of the analysis shows that the significance value for the learning result is 0.845 which is greater than 0.05 then H₀ is accepted. So it can be concluded data on the concept of understanding variables have the same variant so that assumptions are met. For motivation in learning value of significance 0.657 greater than 0.05 then H₀ accepted. So it can be concluded that the data group of motivation motivation variables have the same variant so that the assumption is fulfilled. The next step is multivariate analysis as shown in the table 2. This test is intended to determine whether there is influence or not between learning media variables on the learning outcomes and student learning motivations. The test consists of Pillai's Trace, Wilk's Lambda, Hotteling's Trace, and Roy's Largest Root. The criteria used if (sig.) <0.05 then there is an influence of media use on learning outcomes and motivation.

| Table 2. Multivariate Test |
|-----------------------------|
| Effect | Value | F  | Hypothesis df | Error df | Sig. |
| Intercept | Pillai's Trace | .819 | 1.286E2<sup>a</sup> | 2.000 | 57.000 | .000 |
| Wilks' Lambda | .181 | 1.286E2<sup>a</sup> | 2.000 | 57.000 | .000 |
| Hotelling's Trace | 4.512 | 1.286E2<sup>a</sup> | 2.000 | 57.000 | .000 |
| Roy's Largest Root | 4.512 | 1.286E2<sup>a</sup> | 2.000 | 57.000 | .000 |
| animation | Pillai's Trace | .283 | 11.248<sup>a</sup> | 2.000 | 57.000 | .000 |
| Wilks' Lambda | .717 | 11.248<sup>a</sup> | 2.000 | 57.000 | .000 |
| Hotelling's Trace | .395 | 11.248<sup>a</sup> | 2.000 | 57.000 | .000 |
| Roy's Largest Root | .395 | 11.248<sup>a</sup> | 2.000 | 57.000 | .000 |

The significance value obtained from all outputs is less than 0.05 so, H₀ is rejected. It can be concluded that there is effect the use of computer animation to the learning outcomes and motivation of student learning. Hypothesis testing as shown in the table 3. Hypothesis testing is used to find out whether there are differences in learning outcomes and student learning motivation between learning without using media as a result of development and learning using the developed media.

| Table 3. Hypothesis testing |
|-----------------------------|
| Source | Dependent Variable | Type III Sum of Squares | df | Mean Square | F | Sig. |
| Corrected Model | Motivation | 508.777<sup>a</sup> | 2 | 254.388 | 9.085 | .000 |
| Intercept | Outcome | 3677.646<sup>b</sup> | 2 | 1838.823 | 29.826 | .000 |
| Animation | Motivation | 7050.002 | 1 | 7050.002 | 251.764 | .000 |
| | Outcome | 1921.381 | 1 | 1921.381 | 31.165 | .000 |
| Animation | Motivation | 251.170 | 1 | 251.170 | 8.970 | .004 |
| | Outcome | 1062.746 | 1 | 1062.746 | 17.238 | .000 |
| Error | Motivation | 1624.141 | 58 | 28.002 |  |  |
| | Outcome | 3575.797 | 58 | 61.652 |  |  |
| Total | Motivation | 323417.000 | 61 |  |  |  |
| | Outcome | 294921.000 | 61 |  |  |  |
| Corrected Total | Motivation | 2132.918 | 60 |  |  |  |
| | Outcome | 7253.443 | 60 |  |  |  |
This test is carried out on learning outcomes and learning motivation. Based on the results of the analysis it can be seen the value of all outputs <0.05, it can be seen that H₀ is rejected so it can be concluded that there are differences between the use of instructional media on learning outcomes and student learning motivation. The use of computer animation has a significant effect on student learning outcomes [11], [12]. From the analysis, it is known that the use of computer animation is effective in learning physics. It can be seen from the significant results between the use of computer animation on learning outcomes and students' physics learning motivation.

4. Conclusion

21st-century learning presents technology as a potential solution in reducing the educational problems that are commonly encountered in educational activities. Technology in learning, especially laboratory-based learning should be tailored to the needs and facilities available in schools. Thus, the findings of this study indicate that the use of computer animation has a positive effect on learning outcomes and student learning motivation, so it can be said that this media is effectively used in learning physics.

References

[1] M. Barak, “Science Teacher Education in the Twenty-First Century: a Pedagogical Framework for Technology-Integrated Social Constructivism,” Res Sci Educ., vol. 47, no. 2, pp. 283–303, 2017.
[2] W. Nielsen, K. A. Miller, and G. Hoban, “Science Teachers’ Response to the Digital Education Revolution,” J Sci Educ Technol., vol. 24, no. 4, pp. 417–431, 2014.
[3] J. Wishart, “Exploring How Creating Stop-Motion Animations Supports Student Teachers in Learning to Teach Science,” J Res Technol Educ., vol. 49, no. 1-2, pp. 88-101, 2017.
[4] A. R. Aththibby, “Pengembangan Media Pembelajaran Fisika Berbasis Animasi Flash Topik Bahasa Usaha dan Energi,” J. Pendidik. Fis., vol. 3, no. 2, 2015.
[5] I. Dermitzaki, P. Stavroussi, D. Vavougios and T. Konstantinos “Adaptation of the Students’ Motivation Towards Science Learning (SMTSL) questionnaire in the Greek language,” European J. Psy. Educ., vol. 28, no. 3, pp. 747-766, 2013.
[6] R. M. Guido, “Attitude and Motivation towards Learning Physics,” Int. J. Eng. Res. Technol., vol. 2, no. 11, pp. 2087–2094, 2013.
[7] A. R. Aththibby, S. W. P. Lubis and Y. Ardiyanti, “Tpack as Innovation of Learning Science Laboratory of Indonesia,” Proc. 6th International Conference on Educational Research and Innovation (ICERI 2018). Vol. 330. pp. 135-138, July 2019.
[8] K. Subramaniam, “Teachers’ Organization of Participation Structures for Teaching Science with Computer Technology,” J Sci. Educ. Technol., vol. 25, no. 4, pp. 527–540, 2016.
[9] K. Su, and S. Yeh, “Effective Assessments of Integrated Animations Exploring Dynamic Physics Instruction for College Students’ Learning,” Turkish Onl. Educ. Technol., vol. 13, no. 1, pp. 88–99, 2014.
[10] J. W. Creswell, Research Design Pendekatan Metode Kualitatif, Kuantitatif dan Campuran (4th ed). Yogyakarta, 2016.
[11] K. Altıparmak, “Impact of computer animations in cognitive learning: differentiation,” Int. J. Math, vol. 45 no. 8, pp. 1146–1166, 2014.
[12] R. A. Sumarni, S. P. Astuti and Alhidayatuddiniyah, “Pengembangan Media Pembelajaran Fisika Berbasis Macromedia Flash Pro Cs6 Untuk Kelas X SMAN 115 Jakarta”. J. Pendidik. Fis, vol.6, no.1, pp. 12-20, 2018