Web-Based Animation Video for Student Environmental Education at Elementary Schools

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Abstract—Following the globalization era, the educational system needs technology to prepare the 21st century generation. Students often feel bored with the subject matter delivered monotonously. Technology application can make alternative teaching methods being more interactive to invite students to focus more on learning. This technological advance can transmit the concept visually and allow the students to assimilate the information delivered rather than memorize it effectively. Web-based animation videos as a learning innovation enable learning more enjoyable and students eager to receive subject matter. The web-based animation video is suitable for students in the globalization era in achieving students’ thinking and learning skills. The research objective is to know the effectiveness of using animation videos based on the web in elementary school students' environmental education. This research was conducted in 2020. This research population is elementary school students in the fifth grade at Matraman sub-district in the 2019/2020 academic year in East Jakarta in Indonesia with simple random sampling using the Slovin Formula sampling technique. The data analysis technique applied in this research is the Independent Sample t-Test. In conclusion, it is highlighted that web-based animation videos are used for environmental education at elementary school students.

Keywords—The 21st century generation, web-based animation video, environmental education
1 Introduction

Current technology advancement has vastly improved life quality. Protection of natural resources is crucial for the existence of humanity. Schools must raise awareness of the environment, open their horizons, interact, and behave responsibly. Environmental education is essential to foster new attitudes towards the earth's components involving water, air, animals, and plants, demanding comprehensive thinking. Environmental education must be done effectively in schools to understand nature with great compassion and respect for fellow creatures.

Studies discussing environmental education have been conducted, specifically related to environmental awareness. However, other research is found to have different findings. Some studies found that environmental education can improve student environmental attitudes, leading to positive environmental behavior [1-2]. In line with these findings, environmental education can enhance the environmental moral level [3]. A similar study found that environmental education significantly correlates with environmental ethics and ecological literacy [4-5]. In line with the previous studies, this research presents that the learners having the upper level of comprehension about environmental education have more favorable ecological attitudes than those with lower ones, a more profound control supporting natural word, and sustainable development [6]. In these studies, environmental education prepared students to behave on behalf of the environment, directly impacting environmental quality and achievement in conservation outcomes. These studies also show that environmental education has been highlighted as a relevant tool to transfer information for the students, including knowledge, experience, values, and practices supporting environmentally-related awareness. Environmental education refers to actions that contribute to the students assimilating concepts and practical knowledge, assisting them in environmental problem awareness, and supporting contribution to safeguarding the environment. However, other studies found weak evidence about nature's instruction promoting a more significant surroundings consciousness intensity.

Studies investigating the benefits of using technology in the classroom have increased in the last few years. Their collective findings reported that the application of technology in education could improve student anger management skills, enhance the teaching-learning process's effectiveness, increase academic achievement, and foster positive behavior [7-13]. Other studies presented that the application of technology can raise problem-solving capability, heighten computational thinking competency, upgrade writing ability, be adopted due to usefulness and easiness, and boost motivation [14-19]. The advantages of using technology in education in the cognitive and affective domain are seen in the current studies’ interests.

Regarding academic contexts, technology has been proven to engage the various student learning approaches in terms of accommodating the student learning preferences to change easily [20]. There is empirical evidence showing that technology can enhance students by giving a pleasant experience of learning and analytical abilities due to exposure to animation and simulations provided. However, this empirical evidence was not related to environmental education. Therefore, this
research combines technology with environmental education. This research developed a web-based animation video and learned how to use this technology in student environmental education at elementary schools in East Jakarta in Indonesia. The main research question was: “Did web-based animation video application significantly affect environmental education at elementary schools in East Jakarta in Indonesia?” This investigation attempted to respond to research problems as follows:

a) How is animation video attached on the web for students at elementary schools?
b) Was there any differentiation on the preliminary test and final test of average student environmental education grades through web-based animation video application at elementary schools?

1.1 Educational application design

Adopting technology depends on the effectiveness of using this technology in education to improve information literacy. Previous research proved that developmentally appropriate technology stimulated student computational thinking concept fluency and the development of student interests in computing at the beginning period [15,21]. Other findings stated that applying educational application affected understanding the concept and knowledge, enhancing the learning process, and increasing student learning outcomes [22-25]. These studies indicate that technology enhances the teaching-learning process, student motivation, engagement, and academic achievement. There has been some debate about educational technology application is practical or not. Students accept social media more enthusiastically as an instrument for social relationships than for studying [26].

1.2 Web-based animation video

The application of animated video for education has been shown in several studies to improve students’ achievement [27] and develop student motivation [28]. Hence, in these studies, through an animated educational video, students regarded themselves as engaged in a more central role in reciprocal communication in class, became matted with benefit in learning, and gave exceptional value to technology during the teaching and learning process.

There are many findings regarding the impact of a website application. These studies have shown that using the website attributes to shape positive behavior, acquire knowledge, and attempt to find information and enhance academic achievement [13,29-31]. Other findings stated that using the web can stimulate learning motivation, develop literacy, improve student activity, intensify reading apprehension and learning endurance, and increase student engagement [32-38]. In comparison, another study found that websites reduced student social life [30].
1.3 Environmental education

Some indicators are required to measure student learning outcomes related to environmental education. Many studies about predictors of environmental education were carried out. Some studies found a model through Structural Equation Modeling that environmental education is predicted by fulfilling individual curiosity about nature, enhancing awareness of the environment, and encouraging pro-preservation principles [39-40]. In addition to this, they provided some indicators influencing those three dimensions. Adequately meeting natural curiosity is stimulated by knowledge improvement about nature, positive attitude toward the environment, skill improvement about the environment, and environmental curiosity fulfilled. Awareness increase of nature is influenced by concern about taking care of the environment well, not to ruin the environment, not to exploit the environment, and to feel concerned about environmental cleanliness. Another study has highlighted the intensification of environmental education due to some treatment conducted. Environmental education’s effectiveness can be stimulated by reciprocal learning related to environmental issues, including means of effectively dealing with environmental problems comprising air pollution, detrimental effects of mangrove forest, coastal destruction, and reduction in ozone quantity [41].

There is much information discovered related to the impacts of environmental education. Some studies have presented that environmental education contributes to promoting a higher ecological awareness level, environmental care attitude, environmental knowledge, and skill [42-46]. Many different studies examined environmental education stimulated environmental ethics and environmental literacy, supported environmentally friendly behavior in the community, maintained environmental quality, established environmental experience and value, realized environmental protection, and achieved sustainable development of the natural environment [47-55]. These studies present a range of intended results for environmental education’s role for knowledge, attitudes, and behaviors to develop and support environmental actions positively impacting general environmental excellence of standard and preservation consequence.

This research aims to focus on developing web-based animation videos and highlights environmental issues in them compared to the previous work. This research’s contribution is: (1) developing web-based animation video that is a combination between using the web and animated video as conducted in the previous research, (2) effectiveness of web-based animation video to improve environmental education.

2 Method

This research was conducted in 2019 at elementary schools at the sub-district of Matraman in East Jakarta in Indonesia.
2.1 Design of research

A design of quasi-experimental was applied in this research. A preliminary test was given to the experimental and control group. Both groups selected randomly got different treatment. The experimental group used animation videos based on the web, and the control group used the conventional method. The experimental technique applied in this research is presented in Table 1.

Table 1. The research technique of web-based animation videos effectiveness

|   | O1  | X1  | O2  |
|---|-----|-----|-----|
| E |     |     |     |
| C |     |     |     |

Notes:
E = Experiment group
C = Control group
O1 = Initial test before treatment in the experimental group
O2 = Final test after treatment in the experimental group
O3 = Initial test before treatment in the control group
O4 = Final test after treatment in the control group
X1 = application of web-based animation videos
X2 = application of the conventional method

2.2 Population and sample

This research population consists of 948 students grade five at elementary school students in the academic year 2019/2020 at sub-district of Matraman in East Jakarta located in Indonesia. This research used simple random sampling with the Slovin Formula sampling technique consisting of 137 students for the experimental and control group.

2.3 Research instruments

The test instrument was used at pretest and posttest with identical question characteristics on each test related to environmental education, providing adequate information for the student's natural curiosity, extending environmental awareness, and strengthening pro-conservation values. The pretest was given before the two groups were subjected to web-based animation videos for the experimental and conventional methods was given for the control group. Posttest was given after treatment was applied to the experimental group and the control group. The next step was to compare the pretest results to ones of the posttest for both groups.

2.4 Data analysis

A test for normality was carried out as a prerequisite for the analysis. The normality test in this study used the Kolmogorov-Smirnov test to determine whether the data distribution of experimental and control groups was normally distributed or not. The data is normally distributed if the coefficients of the asymptotic distribution
of Kolmogorov-Smirnov test output are more significant than the specified alpha value of 0.05. A homogeneity test was utilized to determine whether the data groups coming from a homogeneous population or not. The test of homogeneity in this research used Levene’s test. The data is homogeneous if Levene’s test output coefficient is more significant than the pre-specified alpha level of 0.05.

Analyzing data in this research used Independent Sample t-Test Criteria as an inferential statistical test with the value set at 0.05. Rejection of the null hypothesis was done if the result is less than a 5% chance. On the contrary, failing to reject the null hypothesis was concluded if the test statistic is larger than the critical value.

3 Results and Discussions

3.1 Web-based animation video

Some descriptions about web-based animation video resulted as in the following. The product created in this research is called Web-Based Animation Video for Student Environmental Education. The creation process of animation videos in this research used Adobe Illustrator to create characters, Adobe After Effect to form animation, and Adobe Premiere to prepare the videos. This animation video is a combination of animation created, and audio required. Developing web-based animation video was started by choosing wix.com as web home and pressing the button ‘start now.’ It appeared on the sign-up page to be registered as a new user. Choosing a category of the web is the next step to describe web development. Page of Wix editor’s selection was to edit web parts. The selected template can be changed suitably with moving photos, text color changing, and google maps to have web accessories. Web pages can be added adjusted with user needs. Subpages can be added appearing in the dropdown menus.

The web-based animation video's main page appears with having a structure of the title of a 2-dimension (D) animation website completed with the research leader's name. There is a logo of Universitas Negeri Jakarta (UNJ) to the right of the header. This page is equipped with three menu bars located below the UNJ logo. The introduction menu is immediately presented on this main page. Furthermore, there is a 2D animation video menu in the form of a dropdown menu. If the mouse cursor hovers over the menu, it will automatically issue other menus in the form of a dropdown list. The following menu bar is the information menu. Clicking this menu will take the user to another page. This main page is also equipped with all animated videos seen at the bottom of the page.

The page for each video is made separately by the menu's location in the top dropdown menu. It has five different video page sections in the following order: climate change, mangrove forest, waste recycling, biodiversity, and ozone depletion animated video page (Figures 1 and 2). The first animated video page for climate change is about human anthropogenic activities disrupting organic circulations and creating an extended period of alterations in national and worldwide weather. Users
can directly watch the animated video for climate change because it has an auto-play feature or plays itself.

The second animated video page tells about mangrove forests growing in places with many muds and organic matter accumulation such as swamps and brackish water. The mangrove forests are affected by tides and have physical, chemical, biological, ecological, economic, and social functions useful for human welfare. This animated video for mangrove forests can be watched by the user directly because the video has an autoplay feature of plays itself.

The third animated video page is about waste recycling using the reuse-reduce-recycle principle overcoming environmental pollution and improving environmental health. Users can watch the animated video of the waste directly because it has an autoplay feature of plays itself.

The fourth animated video page is about biodiversity determined by geography, topography, climate, rainfall, flora, and fauna being beneficial to human health and well-being. Users can watch the animated video of biodiversity because it has an autoplay feature.

The fifth animated video page is about ozone depletion having direct and indirect impacts on the earth's life caused by anthropogenic activities. The message from this video is that we must reduce anthropogenic activities on land to conserve the environment. Users can watch the animated video of ozone depletion because the video has an autoplay feature.

Fig. 1. Biodiversity animated video page
3.2 The effect of the web-based animation video application on student environmental education

Based on normality test results in Table 2, it can be seen for sample 137 students for control and experiment group. Normal parameters measured by mean as the central tendency of the distribution and standard deviation as variability measurement reaching 36.234 and 5.008 for the pretest control group, 36.365 and 5.162 for pretest experiment group, 49.358 and 2.841 for the posttest control group, 49.883 and 2.665 for posttest experiment group. Table 2 shows that in the experimental group, the Asymp. Sig. (2-tailed) Kolmogorov-Smirnov value obtained in pretest is 0.059 larger than 0.05 and in posttest is 0.154 larger than 0.05. In the control group, the Asymp. Sig. (2-tailed) Kolmogorov-Smirnov value obtained in pretest is 0.052 larger than 0.05, and in posttest is 0.056 larger than 0.05. Kolmogorov-Smirnov calculated value indicated by the absolute value in the most extreme differences for the experimental group in pretest and posttest reached 1.327 and 1.132 and control group in pretest and posttest attained 1.353 and 1.336 less than 0.116 as the Kolmogorov-Smirnov table value. These results indicate that the pretest and posttest data in experimental and control groups are normally distributed as a prerequisite for statistical analysis. It means that it can improve the objectivity and avoid bias in this research.
Table 2. Normality test

| One-Sample Kolmogorov-Smirnov Test | Posttest | Pretest |
|-----------------------------------|----------|--------|
| N                                 | 137      | 137    |
| Normal Parameters                 |          |        |
| Mean                              | 49.883   | 49.358 |
| Std. Deviation                    | 2.665    | 2.84   |
| Most Extreme Differences          |          |        |
| Absolute                          | .097     | .114   |
| Positive                          | .096     | .110   |
| Negative                          | -.072    | -.113  |
| Kolmogorov-Smirnov Z              | 1.132    | 1.336  |
| Asymp. Sig. (2-tailed)            | .154     | .056   |

Table 3 shows that the Levene’s test with degrees of freedom (df1) = 1 and df2= 272 in pretest are 0.732 larger than 0.05 and posttest is 0.807 larger than 0.05. In addition to this, Levene test statistics reach 0.117 for pretest and 0.060 for posttest, which is less than the critical value. These results point out that experimental and control group data are homogeneous, meaning that variance level in these groups is constant across the sample so that probability value is trustworthy and measurement in the different test is produced accurately.

Table 3. Homogeneity of variances test

| Levene Statistic | df1 | df2 | Sig. |
|------------------|-----|-----|------|
| Pretest          | .117| 1   | 272  | .732 |
| Posttest         | .060| 1   | 272  | .807 |

Table 4 shows that the t-test of pretest data with df= 272 in experimental and control groups with sig value 2-tailed is 0.831 larger than 0.05. Besides that, the calculated t-values arrive at 0.214 less than the t-table value. These t-test results indicate that failing to reject the null hypothesis, meaning no significant difference between the pretest of experimental and control groups.

Table 4. Results of t-test in pretest of experimental and control groups

| t-test for Equality of Means |
|-----------------------------|
| t   | df  | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|-----|-----|----------------|-----------------|-----------------------|-----------------------------------------|
|     |     |                |                 |                       | Lower | Upper |
| Pretest | .214 | 272 | .831 | .131 | .614 | -1.078 | 1.341 |
Table 5 displays that the t-test of posttest data with df= 272 in experimental and control groups with sig value 2-tailed is 0.006 smaller than 0.05. In addition to this, the calculated t-values for posttest of experimental and control groups achieve 1.622 more significant than the t-test value. These t-test results indicate that the null hypothesis is rejected, showing a significant difference between the posttest of experimental and control groups.

| t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |
|---|----|----------------|-----------------|-----------------------|-----------------------------------------|
| Post-test | 1.622 | 272 | 0.006 | 0.54015 | Lower: 0.11527, Upper: 1.19556 |

Table 4 and 5 points out that the application of web-based animation video positively affects environmental education for elementary school students grade five at elementary school students in the academic year 2019/2020 at the sub-district of Matraman in East Jakarta in Indonesia. The research results agree that implementing the animation video in learning can enhance student positive experiences and learning gain [27,30]. This tool can keep students away from memorizing lessons but understanding them deeply. It can reduce the concept abstraction to be more concrete so that learning is more meaningful for students. It can also improve the student motivation to analyze information obtained with great curiosity. In addition to the impact of animation video, these findings also align with the study found that website application can get the knowledge and have an effort to seek some information [29], and improve student learning outcomes [30]. Animation video application combined with the website as technology advancement applied in environmental education. Similar to other studies’ findings, individual natural curiosity satisfaction, environmental awareness, and pro-conservation values encouragement stimulating environmental education [39][40] can be enhanced through web-based animation videos.

4 Conclusion

It can be concluded that there is a positive effect of web-based animation video applications on environmental education for elementary school students. Web-based animation video makes it the student easier to understand the teaching material about the environment given. This tool improves the students’ learning experiences to be more motivated to learn about environmental conservation. The students are more aware of solving environmental problems, including air pollution, mangrove forest damage, coastal erosion, and ozone depletion.

Further research can be done to use this tool to enhance student behavior related to environmental conservation at elementary schools. This research aims to provide
elementary school teachers with information to improve their competencies to use technological advancement to maintain environmental quality towards sustainability development. This research's limitations include the scope of research only covering students at elementary schools in East Jakarta. Further research should relate to all regions in Jakarta and other provinces in Indonesia to understand the impact of technology advancement on environmental education.

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