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ENVIRONMENTAL EDUCATION IN ELEMENTARY SCHOOL WITH KAMIHOLO: KAMISHIBAI AND HOLOGRAM AS TEACHING MULTIMEDIA

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ABSTRACT

In environmental education, there have been many studies on learning multimedia, but the media used tends to be limited to the use of conventional media. In this study, we investigate the feasibility of Kamiholo, a combination between hologram and Kamishibai for environmental education in elementary school to improve the students' learning outcomes. To avoid bias and increase objectivity, the learning outcomes of Kamiholo utilization will be compared with those of conventional Kamishibai utilization. The experiments in the control and experimental groups both show good results. However, there is a significant difference in the improvement of the student achievement when learning using Kamiholo based on the N-Gain, where the N-Gain value of Kamiholo and Kamishibai are 0.69 and 0.49, respectively. Overall, we have successfully demonstrated the advantages of our new multimedia by combining holograms and Kamishibai for environmental education.

Keywords: environmental education; hologram; Kamishibai

INTRODUCTION

The declining quality of the environment that threatens the survival of human life and other living creatures requires serious and consistent environmental protection and management by all stakeholders. It is important to provide legal certainty and protection for everyone's right to a healthier living environment to protect the ecosystem, hence the stipulation of the Law of the Republic of Indonesia Number 32 of 2009 on Environmental Protection and Management. The law states that environmental protection and management is a systematic and integrated effort to preserve environmental functions and prevent environmental pollution and/or damage, including planning, utilization, control, maintenance, supervision, and law enforcement. The environment is defined as the unity of space with all objects, forces, conditions, and living things, including humans and their behavior, which affect nature, the continuity of life, and the welfare of humans and other living creatures. Environmental education is held in the school environment to support the efforts of protecting and managing the environment. In line with this, the Directorate General of Primary and Secondary Education of the Ministry of Education and Culture continues to develop and strengthen the implementation of environmental education in schools through several efforts. The efforts include teacher upgrading, an environmental service month program, Guidelines for the Implementation of Population and Environmental Education for Elementary, Junior High, Senior High, and Vocational School Teachers, the *Sekolah Asri (*green school) program, and

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many others. On July 5th, 2005, the Minister of Environment and the Minister of National Education issued a joint decree for the guidance and development of environmental education. It is strongly emphasized that environmental education is carried out in an integrated manner with existing subjects.

In environmental education, learning media is a necessity. While real environmental media can provide better performance, not all environmental learning processes can be held in a supportive ecosystem or while presenting real-life objects. Therefore, the use of information technology media for environmental education can be a good alternative significantly because it can also improve learning outcomes (Fuente, 2020). Many kinds of technology media can be implemented in the classroom, such as presentations, photos, videos, and multimedia. Multimedia for environmental education has shown a positive and significant effect on environmental behavior (Zhuang & Qiao, 2019). In addition, multimedia can increase students' motivation to study environmental education materials with its appeal (Setia et al., 2017).

Moreover, interactive multimedia for environmental education materials can increase students' enthusiasm for learning (Permana & Nourmavita, 2017). However, the type and design of the multimedia used must be selected carefully. According to Saito et al. (2006), multimedia for environmental education needs to be made intuitively, primarily because it will be used as a learning resource for a subject that combines several existing subjects. With that in mind, the variety of multimedia uses that are more meaningful in environmental education needs to be studied further.

In this study, holograms are chosen as the media for displaying 3D images for environmental education learning processes. A holographic medium is better for science learning than ordinary videos and animations and can increase students' motivation and the meaning of learning (Orcos & Magreñán, 2018). In general, students need help to improve their visualization skills to achieve better performance, and holograms have been proven to be a potential solution to improve these skills (Roslan & Ahmad, 2017). On top of that, holographic technology can be used in interactive learning approaches to improve the learning process (Ramachandiran et al., 2019). Also, the use of holograms as learning media has been shown to increase student interest (Dark & Hylton, 2018).

Moreover, the hologram can help students develop STEM competencies (Orcos et al., 2019) and the environmental education included in it. Using a hologram, students can remember, understand, and apply the concepts that have been learned to achieve better learning outcomes (Matere et al., 2021). Finally, meta-analysis-based research shows that hologram technology has positive potential and can attract children's attention to learning and reduce cognitive load (Loh & Shaharuddin, 2019).

There are many kinds of holographic technology that can be used in learning. The pepper ghost concept with holographic pyramids and screens, such as smartphones or tablets, is one of the most widely applied concepts (Awad & Kharbat, 2018; Kim et al., 2018; Patel & Bhalodiya, 2019; Chehlarova & Chehlarova, 2020). The hologram can also be generated using reflections and transmissions produced using simplified holographic recording devices (Park et al., 2020), fans (Loh & Shaharuddin, 2019), parabolic lenses (Matsumaru et al., 2019), and telepresence, which marks the implementation of education 4.0 (Pates, 2020; Themelis & Sime, 2020; Naezak et al., 2021).

The use of holographic media in learning is better accompanied by storytelling to increase concentration and attract students' interest (Kim & Lee, 2020). For instance, Kamishibai is a powerful medium to direct students' emotions and attention (Márques, 2017). Kamishibai is a medium for telling stories using a large colored drawing board to accompany the storytelling (Sibley & Krause, 1995). Kamishibai has proven to be good for use as learning media (Novilia, 2013; Hidaka, 2020; Sundawa et al., 2020; Astutik & Mulyana, 2021). Its use in environmental education has also been tested and increased elementary school students' creativity (Rachman et al., 2017). Students' enthusiasm for learning languages using Kamishibai is shown to be very high, so it is highly recommended to apply it in the learning process (Widiandari et al., 2017). Although Kamishibai is initially only used in storytelling, some teachers have creatively developed different and new implementations (Vermeir & Kelchtermans, 2020). Based on the potential of Kamishibai, this study investigates the implementation of the combination of holographic technology that supports learning in the 4.0 era and the traditional Kamishibai media for environmental education. In this study, the combined media of Kamishibai and the hologram that will be studied is called Kamiholo, which can be seen in Figure 1.

Figure 1. Kamiholo: Kamishibai Hologram

We have explained the development stages of Kamiholo in our previous research (Hernawan et al., 2021). The Kamiholo media uses two monitors. The first monitor is positioned perpendicular to the viewer and is used to display the Kamishibai. The Kamishibai images used in this study are not printed on cards like the conventional Kamishibai but displayed on a monitor screen. The second monitor is laid at the bottom, as in Figure 2. The second monitor displays holographic images that will be reflected on the holographic reflector stored above it.

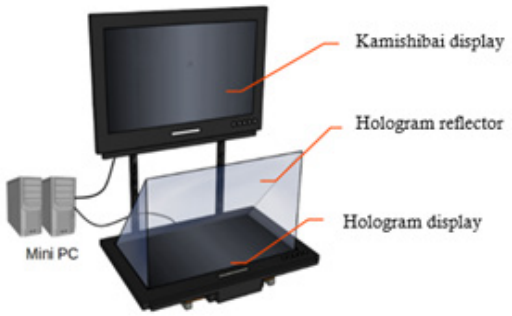

Figure 2. Kamiholo System

Both Kamishibai and Kamiholo have the same content for environmental learning. The learning material presented is about waste: the type of waste, the dangers of waste management errors, and waste management. Although materially the same, Kamiholo has a richer delivery medium. Under its multimedia form, Kamiholo can display supplementary images in three-dimensional images and background music where Kamishibai cannot. However, the lack of three-dimensional images in Kamishibai will not decrease the essence of the learning content.

This study aims to determine the feasibility of Kamiholo utilization as teaching multimedia for environmental education in elementary schools. To avoid bias and increase objectivity, the learning outcomes of Kamiholo utilization will be compared with those of conventional Kamishibai utilization.

METHODS

In this study, the class action research method is used. The experiment is conducted on fifth-grade students at Labschool UPI Cibiru Elementary School. The participants include 50 students, selected randomly and divided into experimental and control groups with the same number of students in each group. The experimental group is given the learning treatment using Kamiholo, while the control is given the learning treatment using conventional Kamishibai. The large groups are further divided into two smaller groups with equal numbers to maintain the COVID-19 health protocol because the experiment is carried out during the pandemic. In addition, this is also done to calibrate the intensity of the learning process. However, the results of this experiment are maintained because the delivery and implementation of the experiments are still carried out using the same procedure. The steps, materials, and narration given to the two groups are the same and follow the same lesson plans.

Figure 3. Classroom Environment in the Experiment Group

The room arrangement for the Kamiholo experiment is held in Multimedia Room as its implementation needs a darker room, as in Figure 3. Meanwhile, the ordinary classroom, as in Figure 4, is used for the Kamishibai experiment because the Kamishibai implementation does not need any particular environment.

Figure 4. Classroom Environment in the Control Group

The material presented is waste classification and management. Before and after delivering the materials, the students are tested on the given material. The detail of the methodology in this research is explained in Figure 5.

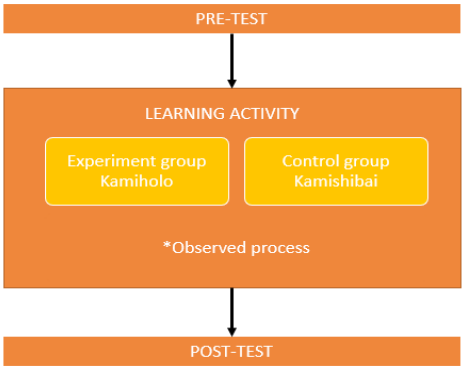

Figure 5. Classroom Experiment Design

Firstly, the students in both groups are asked to do the pretest for 20 minutes in a different room. After that, the teacher continues the learning activity using different multimedia for each group. The learning activity stage is done in around 40 minutes. After the learning, the students from both groups are asked to work on the posttest for 20 minutes. The pretest and posttest are contained the same questions. The tests consist of 15 multiple-choice questions. The questions are related to the material delivered by the Kamishibai and Kamiholo. We also ensure that even though the Kamishibai does not have the 3D image content, the student will still be able to answer the questions of the tests to maintain objectivity. The order of the questions in the pretest and posttest are different to maintain the objectivity and reliability of the test (Hoon & Shaharuddin, 2019).

The effect of the different media on the learning outcome is then analyzed quantitatively by comparing the significance difference using the t-test and re-confirmed using the N-gain value from the pretest and posttest results in each group. By using this method, the difference in learning results can be analyzed. Before the data analysis is carried out, the data is also tested for normality to ensure its reliability and validity using SPSS by Kolmogorov Smirnov technique and Microsoft Excel.

More data are obtained from observers during the experiments. There are two observers in each group. The observers fill out questionnaires based on observations while also observing the experiments qualitatively. After the learning process, the observers are interviewed to identify their findings in class. Informal observations are essential to capture the students' experiences as they watch 3D (Hoon & Shaharuddin, 2019). Thus, there are quantitative data and qualitative data in this study.

RESULTS AND DISCUSSION

The data are tested for normality of distribution using the Kolmogorov Smirnov technique on SPSS. If the significance value is above 0.05, then the analyzed data is normal and does not need to be normalized again. As in Table 1, the average scores of each group are above 0.05. It means the data on student scores can be used entirely, and nothing should be left behind.

Table 1. Normality Test Result

		Standard Deviation	Asymp. Sig. (2-tailed)
Kamiholo	Pretest	15.300	0.161
	Posttest	16.760	0.111
Kamishibai	Pretest	17.200	0.123
	Posttest	16.450	0.128

All groups, both the experimental group using Kamiholo and the control group using Kamishibai, experienced an increase in the average score from the pretest to the posttest score. However, there is a higher difference in the group that used Kamiholo as learning media. The experimental group using Kamiholo has a difference in the pretest and posttest scores of 33.67, while the control group using Kamishibai has a different value of 22.67, as in Figure 6. The average difference between the Kamiholo group is 10 points ahead of the Kamishibai group. Based on these differences in average scores, we can assume that the average learning outcome of the group supported by Kamiholo is better than that of conventional Kamishibai. However, it should be confirmed with other statistical methods.

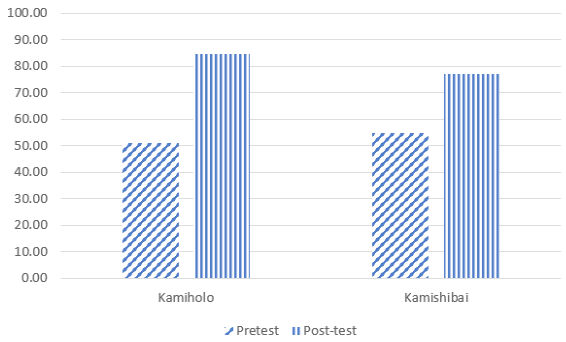

Figure 6. Students' Average Score

An N-gain analysis was performed to confirm the difference in the pretest and posttest scores of the two groups, as in Table 2.

Table 2. N-Gain Result

	Difference	N-Gain
Kamiholo	33.67	0.69
Kamishibai	22.67	0.49

N-gain can be used to measure the increase in scores before and after learning by assessing the difference between the normalized pretest and posttest mean scores. Based on the N-gain analysis, the increase in the value of using Kamiholo is higher than the increase in using Kamishibai.

Furthermore, the scores are analyzed using the Paired Samples t-test on SPSS to ascertain the significant difference between the pretest and posttest scores for each group. The results of the paired sample t-test in Table 3 show a significant difference between the pretest and posttest scores of each group.

Table 3. Paired Sample t-test

	T	**df**	**Sig. (2-tailed)**
Kamiholo_Pretest - Kamiholo_Posttest	7.74	24.00	0.00
Kamishibai_Pretest - Kamishibai_Posttest	6.32	24.00	0.00

With a 95% confidence value, the groups' two significance values (Sig. (2-tailed)) are both less than 0.005. Moreover, the t-value of the results of the two groups is greater than the t-value for df 24. Therefore, it can be concluded that the mean values of the pretest and posttest of the Kamiholo and Kamishibai groups have significant differences. However, based on the average results and the N-gain analysis, the increase in scores in the Kamiholo group significantly improved more than in the Kamishibai group.

Overall, the control and experimental groups' experiments show good results. It can be implied that both Kamiholo and Kamishibai are suitable teaching media for environmental education in elementary school. However, there is a significant difference in the improvement of the student achievement when learning using Kamiholo. It also can be implied that Kamiholo is better than Kamishibai in improving the learning outcome of elementary school students when they learn environmental education. It is shown from the students' pretest and posttest scores and based on observations during the experiments. The holographic media created a *wow moment* and increased students' motivation to learn. The effectiveness of 3D holograms is apparent in the students' increased motivation (Hoon & Shaharuddin, 2019). From the first time the students saw the Kamiholo device, even before it was operated, they showed curiosity and eagerness to start the lesson because they wanted to see the hologram. Their reaction is different from the use of Kamishibai with conventional picture cards because some students felt they were used to seeing picture cards or posters. Students who were given treatment using Kamishibai even complained because they wanted to learn using Kamiholo to experience the learning using holograms.

Findings revealed that the students could engage in fundamental concept material and hologram experiments (Matere et al., 2021). That finding of hologram utilization was also found in our experiment. Students who learned using Kamiholo showed a higher interest in learning by making the classroom atmosphere livelier during the learning process. The students could focus on the material presented in a multimodal manner: 2D images, 3D images, accompaniment music, and story narratives delivered by the teacher. After class, the students still showed interest by asking questions about the 3D objects displayed by

Kamiholo. This condition did not appear in the control class that used conventional Kamishibai because the learning process was not supported by the display of 3D objects, even though the class atmosphere was as lively. Communication among the participants seems to have been promoted by the Kamishibai (Murata et al., 2019). So, we can imply that the experiment group gets the beneficial effect of both Hologram and Kamishibai, while the control group only gets the beneficial effect of Kamishibai. From this observation, we assume the Hologram and Kamishibai positively correlate if we use both together. However, we have to statistically analyze that with further data and evidence to conclude that possible relation.

The observer teachers were appreciative and gave positive comments on the Kamiholo. They also provided constructive input regarding the possibilities of using Kamiholo in other subjects. Based on the experiments that have been carried out, Kamiholo is proposed to be used in other subjects. Kamiholo is very good for displaying objects that cannot be brought into the classroom or that have abstract concepts, for example, in science or history subjects. The presentation of the material is also still very appropriate if it is done by telling stories. In addition, Kamiholo will significantly assist students' cognition in understanding the concept of objects that are more difficult to explain in 2D media, such as those in mathematics. Although in mathematics, delivering material using picture stories may be more difficult, a monitor used as a story image can be used to display other additional information.

Despite the benefits and potentials offered by Kamiholo, the observer teachers believed that the success of learning would also depend on the teacher's storytelling and class management ability. The same is valid for learning using conventional Kamishibai. Without the skill and ability of a teacher in storytelling and class management, the objective of learning cannot be achieved. The students will be distracted by the *wow effect* of the media instead of focusing on the learning because the media make them wonder. The teachers felt they needed to be given more training and motivation to improve the learning outcomes, both when using Kamiholo and Kamishibai.

There is also another challenge faced by the implementation of Kamiholo in an actual classroom environment. The monitor used for the experiment was a regular monitor with a brightness of fewer than 500 nits. Based on the experimental results, the brightness of typical classrooms will obscure the 3D display produced by the hologram viewer. Therefore, the learning activities using Kamiholo must be carried out by closing the light sources that enter the classroom or in a designated room that is darker. During the experiment, plastic film was used to increase the monitor's brightness slightly. This problem can be circumvented in further development of Kamiholo by replacing the hologram display with monitors with higher nit levels. Another improvement we currently work on is the addition of a hand gesture sensor to make the hologram system in Kamiholo more interactive.

CONCLUSION

Based on the experiment on experiment and control group, it can be concluded that the environmental learning process using both Kamiholo and conventional Kamishibai can improve the student's performance in understanding the learning material. However, the improvement in Kamiholo usage shows better results. It can be seen from the statistical evidence—the observer who in-charge in charge of every experiment is also in line with the statistical result. The student feels more motivated because of the *wow effect and is* interested in new technology being used for the learning process. Our experiment results show that Kamiholo is feasible and even highly recommended to be used as teaching media in environmental education. Overall, we have successfully demonstrated the advantages of our new multimedia by combining holograms and Kamishibai for environmental education. The teachers suggest using Kamiholo for other subjects, especially when the learning material is more abstract. In response to the existing problem of Kamiholo, currently, we are building a better Kamiholo version by enhancing the brightness so it can be used not only in dark rooms but also in brighter rooms.

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