The Effect of Science Digital Scrapbook Based on the Universal Design for Learning (UDL) on Students'

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ABSTRACT
The students' learning outcomes in the COVID-19 pandemic era were declining. Science learning resources are often not suitable for online teaching and learning. The Science Digital Scrapbook has been developed based on the Universal Design for Learning (UDL) to support science teaching and learning. This study aimed to examine the effect of the Science Digital Scrapbook based on UDL on the students' learning outcomes. This study was quasi-experiment research that utilized a post-test-only control-group design. The participants were students in Class VIII C and VIII D at SMP N 24 in Semarang. Students' social cognitive learning outcomes were assessed using a test. The Mann-Whitney U was used to compare the post-test between the two groups. The results indicated that the students' cognitive learning outcomes were higher in the experiment group compared to the control group. It is concluded that the Science Digital Scrapbook is an effective learning resource to improve students' learning outcomes.

Keywords: learning outcome, scrapbook, science digital universal design for learning

1. INTRODUCTION

The COVID-19 pandemic has impacted all life sectors, and the education field is no exception [1]. One of the policies taken in the education field is the implementation of learning from home for students, starting from elementary to university level [2]. The problem of teaching during the COVID-19 pandemic has become a serious problem throughout the world, including in Indonesia. Learning from home can be done either online or offline. Most of what is done in Indonesia is carried out online, especially for students living in internet-accessible areas. This online learning utilizes internet media and other supporting technologies [3].

Online learning is carried out by utilizing technology and communication for the continuity of the teaching and learning process during the pandemic period [4]. Online learning is defined as a transfer of knowledge that was conducted using internet network support, video, audio, images, text communication, and software

[5]. Online learning requires educators and students to maintain the interaction between them in the transfer of knowledge. Online learning utilizes various platforms, such as applications, websites, social networks, and also learning management systems. These various platforms are beneficial to support knowledge transfer, that are supported by various discussion techniques and other features [6].

Several obstacles have emerged as a result of changed learning methods which include (1) teachers' lack of knowledge to vary educational media; (2) teachers focusing on providing learning modules, (3) learning discrepancy with the lesson plan, and (4) teacher-centered learning [7]. On the other hand, learning activities during the Covid-19 pandemic should be interesting to students and avoid monotonous activities. Teachers must also provide quality learning facilities that stimulate critical, creative, and productive thinking skills as well as develop life skills. Therefore, it is essential to develop attractive and varied digital

teaching materials to stimulate students' learning motivation [8].

Science learning is not only about aspects of knowledge but also a procedural aspect. One of the topics in science learning that is considered very complicated is the digestive system [9]. Students are required to know food as a source of nutrition, the organs that make up the digestive system, and their functions, as well as diseases and efforts to maintain the organs' health. This topic consists of many sub-materials that must be conveyed through visual media, where students must know the shape of the organs that make up the digestive system and their functions. Teachers were aware that their lack of understanding about the online learning media could result in students' inability to comprehend the materials. Therefore, the use of learning media on the materials needs to be optimized. Moreover, adequate teaching materials are needed to facilitate students to carry out independent learning accompanied by simple practicum activities. Similar activities to prove the various kinds of nutrients needed by the human body at home by using daily chemical materials have been reported previously in a study [10].

To provide alternative learning material, a science digital scrapbook based on Universal Design for Learning (UDL) according to the 2013 Curriculum has been developed [11]. The Science Digital Scrapbook is a digital interactive teaching media containing Digestive System materials for the odd semester of Grade VIII. It adopts the concept of UDL, which emphasizes learning for all student profiles in inclusive classes by following three principles; representation, action and expression, and engagement. This UDL principle is considered because all schools in Semarang are inclusive thus also cater to special needs students.

Based on the characteristics of the preparation of online teaching materials [12], the UDL-based Science Digital Scrapbook is suitable for use as teaching material for online learning because (1) it is made in digital format, (2) it covers a large topic that needs to be divided into sub-topics, (3) the documents are in HTML, txt, doc, pdf, ppt, Xls, jpg, SWF, zip, mp3, MPEG, MOV, WMV, etc.; and (4) it corresponds the suggested file size (5 MB max). These files need to be organized so that they are easy to find and use in preparation for e-learning implementation, whether using LMS, authoring tools, or another web programming. This study was aimed at evaluating the effect of the UDL-based Digital Science Scrapbook on student learning outcomes at SMP Negeri 24 Semarang, Indonesia.

2. MATERIAL & METHODOLOGY

The research, which was conducted at SMP 24 Semarang, was quasi-experimental. The design adopted a post-test-only intervention and control design (experimental and control classes). The research subjects were grade VIII C as the experimental class and VIII D as the control class consisting of 25 students each. The sample was determined using a cluster random sampling technique.

Data were collected through tests in the form of multiple-choice comprising 30 test items. Before constructing the test items, a test grid was developed according to the digestive system materials with varying cognitive levels ranging from C1 to C6 levels to describe the cognitive learning outcomes. The developed test items were then undergone validity and reliability assessments. The results showed that they were valid and reliable to use as research instruments to measure students' cognitive learning outcomes on the digestive system topic.

The data obtained were firstly analyzed using descriptive statistics. Statistical calculations were conducted to determine the mean, median, mode, and standard deviation scores. The statistical calculations included (1) analysis of prerequisite test consisting of normality and homogeneity test, and (2) hypothesis test, carried out by considering the analysis prerequisite test. If the data were normally distributed, an independent t-test should be used, and if the data were not normally distributed, the Mann-Whitney U test would be used.

3. RESULTS AND DISCUSSION

This study studied the student learning outcomes after using the developed scrapbook in VIII grade students of SMP N 24 Semarang. The student's understanding of the materials could be derived from the learning outcomes, which referred to the scores of students' test results before and after doing the learning activities. Two essential and interrelated aspects of learning are the selection of media and learning methods. The comparison of the two classes' average learning outcomes is presented in the following Table:

Table 1. Descriptive Statistics

Criteria	Experimental Class (UDL-based Science Digital Scrapbook)	Control Class (Science Textbook)
Mean	82.9200	69.64
Max Score	100	97
Min Score	50	37

Table 1 shows that the experimental class's highest score was 100, and the lowest was 50, with an average

of 82.92. On the other hand, the control class's highest score was 97, and the lowest was 37, with 69.64. Descriptively, the average score of the experimental course was higher than the control class.

Table 2. Normality test

	Class	Kolmogorov-Smirnova		
		Statistic	df	Sig.
Learning outcomes	Experimental Class (UDL-based Science Digital Scrapbook)	.128	25	.200 *
	Control Class (Science Textbook)	.258	25	.000

The data are typically distributed when having a value bigger than 0.05. Thus, based on Table 2, the control class' sig. Value was <0.05, so that the data were not normally distributed. Consequently, further analysis shall use the non-parametric statistics of the Mann-Whitney U test. The basis of the Mann-Whitney test's proof is if H0 (Asymp. Sig.> 0.05) is accepted, then the UDL-based Science Digital Scrapbook does not affect student learning outcomes. If H0 is rejected, then the UDL-based Science Digital Scrapbook is declared to influence student learning outcomes. The description of the Mann-Whitney result analysis is presented in the following Table.

Table 3. Mann-Whitney U

Statistic	Value
Mann-Whitney U	169.000
Wilcoxon W	494.000
Z	-2.803
Asymptotic. Sig. (2-tailed)	.005

Based on Table 3, the asymptotic value. Sig (2-tailed) was 0.005 or smaller than 0.05, indicating that the Ho hypothesis was rejected. Hence, it can be stated that the UDL-based Science Digital Scrapbook influenced the student learning outcomes. The effect size was analyzed with the criteria of under 0.5 as minor, between 0.50-0.80 as moderate, and above 0.8-2.0 as large. The calculation results obtained that 1,573 were in the range of 0.8-2.0. Therefore, they had a large or significant effect.

Based on the research results, teachers as facilitators must provide convenience in online learning activities in the form of media/digital teaching resources [13-14]. Science digital scrapbook based on UDL is a digital teaching material that can be accessed through students' gadgets and PCs. Based on the Mann Whitney U test and the effect size, it had a significant effect on student learning outcomes as it was designed following the 2013 curriculum, which covers both the cognitive domain of Basic Competencies 3.5, namely "analyzing" the digestive system in humans and understanding disorders related to the digestive system as well as

efforts to maintain a healthy digestive system." In addition, it also facilitated learners to achieve Basic Competencies 4.5, namely "presenting the investigation results on mechanical and chemical digestion" [15].

Learning science using the activity steps contained in the UDL-based SDS helped the students acquire the concept of the digestive system. The topic is divided into several sub-topics, including nutrition, organs of the digestive system, and efforts to overcome diseases in the digestive system. The students carried out practical activities using daily chemicals based on the procedural videos provided in the media. Hence, though the practicum was performed independently, the students could do it well and safely, referring to the clear and standardized steps. They also gained experience from the independent investigation of mechanical and chemical digestive processes according to the Basic Competencies 4.5, then presented the investigation results. This individual activity followed the UDL design principle, action, and expression, which is beneficial for them to construct their knowledge well [16]. Another manifestation of this principle was the provided practical instructions in videos, which made it convenient for the students to follow [17]. Referring to [18], if someone gains knowledge from an invention, then that person can improve the ability to find and solve problems. The students in the inclusive class were interested and enthusiastic in carrying out the practicum. The completeness evidenced this in submitting practicum reports.

The UDL-based Science Digital Scrapbook contains minimalistic pictures and descriptions, which becomes one of the main characteristics of a scrapbook [19], [20] & [21]. The materials are presented in the form of visual images accompanied by simple descriptions along with the audio to facilitate slow learners or special needs students in inclusive classes who may have difficulty understanding long sentences. Besides that, there are also explanatory videos about organs and digestive processes in the human body. This follows the principles of representation in the UDL, which provides supporting facilities to deepen the meaning in various ways.

The UDL principle also facilitates action and expression as an effort to support strategic ways of learning. Moreover, it provides opportunities for students to demonstrate their understanding in various forms, such as through tests, papers, art, multimedia presentations, and digital recordings [22]. At the end of each sub-topics, cognitive difficulties are available as an exercise for students to remember the materials they have learned. Further, reinforcing activities are also given, such as matching pictures of organs with their names and functions and making practicum recordings.

The students were excited to present their work due to these various activities instead of item drilling, which has become a scourge in online learning.

The experimental class' science learning outcomes were enhanced as the Science Digital Scrapbook supplies diverse ways of engagement to assist effective learning and to consider how to involve students in stimulating their interest and motivation through collaborative learning, games, and simulations, real and virtual [16],[23]. This principle is facilitated through the observation of practicum simulation activity before carrying out independent experiments so that students are involved in reporting the practicum process. Each student's practicum results collaborated with their friends. Other than that, the students also accessed the content on their own, which resulted in a better mastery of content compared to when they were directed by the teacher.

A study proved that scrapbooks can improve student learning outcomes and are superior to other media[24]. Similarly, this study's findings unveiled that there was a difference between the students learning using the UDL-based scrapbook and those taught using conventional printed books [25], [26], [27]. A concrete learning experience guarantees learners' thinking skills development [28]. Scrapbook is an audio-visual medium comprising moving images and sound effects [29]. It made activities more interesting in the experimental class [30] and stimulated the learners to answer questions and do assignments following those contained in the media [31].

The UDL-based Science Digital Scrapbooks also enabled students to have more time in learning than studying could be carried out anywhere and anytime [32]. This learning activity contribute to the varied learning resources. Furthermore, the technological developments in the industrial revolution era have changed people's lives as every individual is required to follow technological developments [33].

4. CONCLUSION

The Science Digital Scrapbook based on UDL improved student learning outcomes compared to the control group. Thus, it is concluded that the UDL-based Science Digital Scrapbooks are beneficial in improving students' learning outcomes.

AUTHORS' CONTRIBUTIONS

IUW developed the theoretical formalism, performed the analytic calculations, contributed to the final version of the manuscript; SS and NJ implemented the research.

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