Digital Environment Learning (DEL): Creativity in Framework of Digital Literacy

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Keywords:	Abstract
digital environment; *creativity;* *digital literacy*	*The surge in digital literacy emerged as a prominent trend during the era of online learning in elementary schools. However, the success of connecting the digital environment to the learning process is contingent upon the teacher's proficiency. Consequently, we introduced DEL (Digital Enhanced Learning), an instructional approach that fully integrates digital technology into all learning devices. This study seeks to assess students' digital literacy and creativity during DEL activities in elementary schools conducted over a period of 10 weeks. A total of 290 students participated in the DEL activities. Students' digital literacy and creativity were evaluated using two instruments: DELQ (Digital Enhanced Learning Questionnaire) and CET (Creativity Evaluation Tool). DELQ gauged students' digital literacy, while CET assessed creativity. ANOVA was employed for data analysis to evaluate the consistency and achievement of students. The findings of this study indicate that DEL activities contribute to enhanced creativity, specifically in the aspects of fluency and elaboration. Students' digital literacy plays a pivotal role in supporting the fluency and elaboration processes during learning activities. Moreover, the effectiveness of DEL activities, as perceived through students' digital literacy, indicates an improvement in knowledge related to digital literacy. In summary, this study underscores the positive impact of digital-based activities in fostering both digital literacy and creativity among elementary school students.*

INTRODUCTION

Background of the Study

Digital literacy is the ability to use technologies to find, evaluate, create, and communicate information, which requires cognitive and technical skills (Forsling, 2021; Maureen et al., 2018; Saputra & Al Siddiq, 2020). In online learning, digital literacy is needed to be able to run learning efficiently (Mihailidis, 2015; Umut Zan et al., 2020). Thus, the learning carried out becomes more dynamic in terms of learning content (Pradana, Sholikhah et al., 2020) and fosters student creativity (Webster et al., 2006).

Problem of the Study

Digital literacy in Indonesia lags behind that of other ASEAN countries, with an average of approximately 70%, whereas Indonesia's digital literacy rate is at 62%. Moreover, the digital literacy standing of the Indonesian populace is marked at 3.54 on a 1-5 scale, covering evaluations of digital skills, digital safety, digital culture, and digital ethics (Larasati, 2021). In the 21st century, technology has become integral to the educational process. Currently, Information and Communication Technology (ICT) facilitates learning to be more effective, creative, innovative, and encourages the enhancement of pedagogical approaches for fostering student creativity (Andriani, 2015). The selection of information sources to autonomously construct knowledge is pivotal in ensuring the learning process unfolds seamlessly, encompassing not only theoretical delivery but also the ability to solve problems (Shopova, 2014).

Research's State of the Art

Previous research examined digital literacy as a technology-based learning model (Liu et al., 2020; Talib, 2018). Next, compare digital and non-digital instructions to see students' cognitive processes (Garofalo & Farenga, 2019). However, it is still not discussed related to student creativity. Research related to creativity is mostly done by developing learning models based on student creativity (Doppelt, 2009; Wong & Siu, 2012). However, the model of using technology in online learning has not been explored. To be able to develop creativity, a learning system is needed that can facilitate students to do anything dynamically (Middleton, 2005).

Gap Study & Objective

Despite the growing importance of digital literacy and technology-based learning models, there is still a notable gap in understanding how these approaches influence student creativity in online education. While various studies have explored creativity in traditional learning environments, little attention has been given to investigating the impact of technology-based learning on nurturing student creativity. The existing research focuses on the development of learning models centered around creativity but fails to address the potential of integrating technology for this purpose.

Based on these issues, DEL is designed as an online learning system as well as a model for learning activities. DEL activity is designed to provide dynamically manipulated media. Based on this, this study aims to demonstrate the effectiveness of DEL activity by looking at digital literacy and student creativity. In DEL activities, students can freely manipulate objects, see visualizations and be creative to present problem solutions. By using DEL in learning, we hope that students' creativity can be facilitated and developed well.

METHOD

Type and Design

This research aimed to investigate students' digital literacy and creativity resulting from DEL activities. The initial phase involved introducing DEL to elementary school teachers, along with a manual book for DEL. Subsequently, the study proceeded with the selection of schools to implement DEL, based on specific criteria such as reliable internet access, integration of digital resources into the curriculum, utilization of interactive learning platforms, and teacher training in digital pedagogy. In the third phase, teachers incorporated DEL into their teaching processes, covering thematic and mathematics learning, over a span of 10 weeks. Upon the completion of the DEL activities, the final step entailed assessing students' digital literacy and creativity to fulfill the research objectives.

Data and Data Sources

The participants in this study comprised elementary school students selected through stratified cluster random sampling. The initial group consisted of 147 students, allocated to the intervention group engaging in DEL activities across six classes. Each class had a teacher facilitating the learning process during DEL activities. For comparative purposes, a non-intervention group of 143 students was selected, participating in traditional learning without DEL. The summarized details of all participants are presented in Table 1.

Table 1. Characteristics of the participant

Group	N (by group)	N (by grade)	N (by class)	N (by gender)	Mean age	Range Age
Intervention	147	37 fourth grade	2	63 males	11.4	10.7 –
		58 fifth grade	2	84 females		12.3
		52 sixth grade	2			
Non-intervention	143	48 fourth grade	2	65 males	11.1	10.4 –
		54 fifth grade	2	78 females		12.5
		41 sixth grade	2			

Data collection technique

In this study, we were examining digital literacy and creativity. We examine digital literacy by using Digital Literacy Examinator Questionnaire (DLEQ). The DLEQ involves 4 aspects, 11 indicators, 20 items (see Table 2). We made the DLEQ in multiple choice answer to make it easier for students to fill it out. The reliability coefficient of DLEQ was 0.827. Furthermore, we explore creativity using Creativity Examinator Test (CET). The CET involved the thematic and mathematics problem in checklist form (10 item). The students can choose more than one of presented solution or create their own solutions. The indicator of creativity in this study presented in Table 3. The reliability coefficient of CET was 0.843.

Table 2. Digital literacy indicators

Aspect	Indicator
Network	Downloads music or video clips from Internet
	Can create or edit picture files
	Communicates frequently through computer messenger
Technical	Uses reservation functions of home appliances such as TV, washer, and
	rice cooker
	Utilizes additional functions of mobile phone
Computer	Has no difficulty in turning on or off computer or monitor

	Aware of icon meanings on computer desktop
	Can communicate through several different channels on the Internet
Information	Gains information on places or goods through the Internet
	Reads Internet newspapers
	Aware of websites providing information in areas of interest

Table 3. Indicator of creativity

Aspects	Indicator
Fluency	Summarizing the answers
	Critiquing the objects or situation
	Producing Ideas
Flexibility	Attributing situation
	Organizing situation
	Planning different answers
Originality	Producing new things
Elaboration	Differentiating ideas
	Planning to solve problem with procedural ways

Digital Environment Learning (DEL)

DEL is learning that utilizes digital technology in all learning devices. The scope of DEL includes lesson planning, learning materials, problem presentation, assessment, and exams. DEL was designed to meet online and offline learning needs. This can give teachers the ability to explore more while using technology to hone students' digital literacy and creativity skills. By paying attention to the elementary school curriculum, the learning objectives can be achieved.

Procedure

We were introducing DEL to teachers eight weeks before the activity. The activity involved creates lesson plan using DEL. After that, ten weeks of learning activities carried out. Teachers teach thematic and mathematics. A week after the lesson was over, CET and LDEQ conducted. The students take CET and LDET for 60 minutes. We held the CET and LDEQ online.

Data analysis

The first analysis was carried out to examine consistency of DEL activity. So, the student' digital literacy and creativity before DEL activity can be identified. We analyzed the consistency of DEL activity using ANOVA. The second analysis was to find out the achievement of creativity and digital literacy. We used ANOVA to analyze it.

RESULTS

The findings of this study are presented in three sections. The initial part addresses the consistency of DEL activity, focusing on the participants' baseline abilities. The second segment compares the intervention and non-intervention groups concerning students' creativity and digital literacy. The third part explores the correlation between creativity and digital literacy. Mean and standard deviation values are provided in Table 4, and the mean comparison between the intervention and non-intervention groups is illustrated in Figure 1.

Table 4. Mean and standard deviation of creativity and digital literacy in DEL activity

Group	Creativity								Digital Literacy	
	Fluency		Flexibility		Originality		Elaboration			
	M	SD	M	SD	M	SD	M	SD	M	SD
Intervention	12.61	4.04	11.96	4.26	10.86	3.04	11.82	3.53	17.50	6.09
Non-intervention	11.03	3.97	11.29	4.11	10.46	2.59	10.57	4.03	16.24	6.14
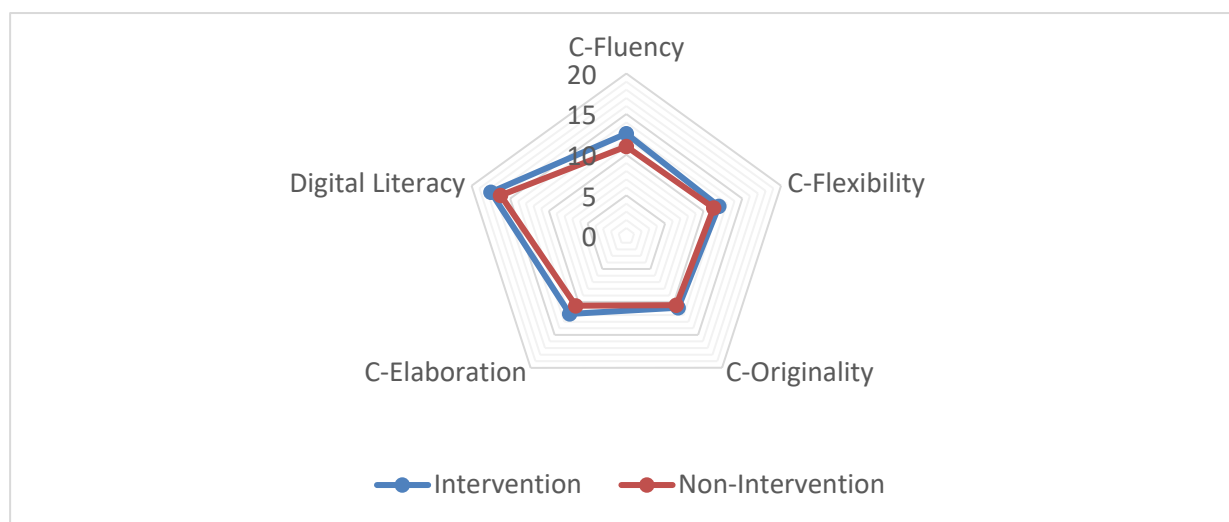
Figure 1. Mean comparison of intervention and non-intervention group

Consistency of DEL Activity

A conservative α = 0.01 (p-value) was applied for ANOVA, revealing no statistically significant differences between the intervention and non-intervention groups F (1, 289) = 4.29, p = 0.13. This analysis indicates that students' initial abilities were comparable before engaging in DEL activities. This consistency analysis is pivotal, signifying that the divergence between the two groups after the activity is attributed to the implementation of DEL. A summary of this analysis is presented in Table 5.

Table 5. Consistency of DEL activity (initial ability)

Group	df	F	p (0.01)	Decision
Intervention vs non-intervention	(1, 289)	4.29	0.13	Accept H_0

The Effectiveness of DEL Activity in Terms of Creativity

The effectiveness of DEL activity is presented by analyzing mean of creativity. In terms of creativity, we were comparing all of creativity aspects between two groups. The fluency aspect result shown that there was significant difference between two group F (1, 289) = 9.28, p < 0.01. This result represents that student at intervention group have better creativity in fluency aspect. The flexibility aspect result showed that there was no significant difference between the two groups F (1, 289) = 5.71, p = 0.26. This result represents that the students at both groups have same creativity in flexibility aspect. The originality aspect result showed that that there was no significant difference between the two groups F (1, 289) = 3.94, p = 0.18. This result represents that the students at both groups have

same creativity in originality aspect. The elaboration aspect result shown that there was significant difference between two group F (1, 289) = 10.39, p < 0.01. This result represents that student at intervention group have better creativity in elaboration aspect. The summary of this analysis presented in Table 6.

Table 6. Analyze effectiveness of DEL activity in terms of creativity

Creativity	df	F	p (0.01)	Decision
Fluency	(1, 289)	9.28	< 0.01	Reject H_0
Flexibility	(1, 289)	5.71	0.26	Accept H_0
Originality	(1, 289)	3.94	0.18	Accept H_0
Elaboration	(1, 289)	10.39	< 0.01	Reject H_0

The Effectiveness of DEL Activity in Terms of Digital Literacy

The mean score of digital literacy was compared to assess the effectiveness of DEL activity. Analysis of the DLEQ data revealed a significant difference between the two groups (F (1, 289) = 10.79, p < 0.01). This outcome indicates that students in the intervention group exhibited higher levels of digital literacy. Consequently, DEL activity proved to be instrumental in developing students' digital literacy.

Correlation Between Creativity and Digital Literacy

Additionally, we investigated the correlation between creativity and digital literacy, focusing on the fluency and elaboration aspects. The correlation analysis between the fluency aspect and digital literacy suggests that students with proficient fluency processes are supported by their digital literacy during DEL activity. Similarly, the correlation between the elaboration aspect and digital literacy indicates that students engaging in elaborative processes are also supported by their digital literacy during DEL activity. A summary of this analysis is presented in Table 7.

Table 7. Correlation between creativity and digital literacy

Correlation	p (0.01)	Pearson	Decision
Fluency and digital literacy	< 0.01	0.683	Positive
Elaboration and digital literacy	< 0.01	0.711	Positive

DISCUSSIONS

The outcomes of this study suggest a notable enhancement in students' creativity through the implementation of DEL activity, specifically in the dimensions of fluency and elaboration. This underscores the idea that technology-infused learning activities can effectively foster creativity among students. Prior research has similarly demonstrated positive results in assessing students' creativity using digital tools (Balakrishnan, 2021; Hourcade et al., 2010). The unique aspect of DEL activity lies in providing a learning environment that not only incorporates digital media but also encompasses a comprehensive digital learning system.

In addition to creativity, the study delves into digital literacy within the context of the DEL activity. The utilization of digital media in the DEL learning environment has sparked increased interest among students in using and manipulating digital tools, submitting assignments online, and promptly accessing grades. This aligns with previous research highlighting that the integration of digital media allows students to manipulate objects in the learning process (Pradana, Sa'dijah et al., 2020; Pradana, Sholikhah et al., 2020). Although the current study doesn't explicitly discuss planning and assessment

in online learning, it underscores the experiential benefits gained by students through DEL activities, contributing to the development of creativity and reasoning.

Early exposure to technology, as facilitated by DEL, is seen as a catalyst for students' cognitive development (Dashti & Yateem, 2018; Lin et al., 2015; Zanatta et al., 2019). The symbiotic relationship between creativity and digital literacy is evident, with digital literacy-based activities serving as a facilitator for honing students' creativity, particularly in fluency and elaboration. The dynamic nature of learning content enhanced by digital technology promotes effective fluency and elaboration. Past research has posited that creativity can be discerned through activities grounded in technology (Doppelt, 2009; Middleton, 2005; Schoevers et al., 2019). Consequently, the integration of technology in education emerges as a pivotal factor in facilitating students' holistic development, especially in nurturing creativity.

CONCLUSION

This study reveals a positive correlation between creativity and digital literacy within the framework of DEL activity. Creativity demonstrates indirect improvement as long as digital literacy is fostered during DEL sessions. The activity effectively enhances students' creativity performance, particularly in the aspects of fluency and elaboration. Additionally, the effectiveness of DEL activity, as observed through students' digital literacy, indicates an improvement in knowledge about digital literacy. The fluency and elaboration aspects exhibit a positive correlation with digital literacy, suggesting that DEL activity serves as a bridge from digital literacy to creativity. Hence, DEL activity is strongly recommended for teachers who prioritize fostering creativity in their learning processes, especially at the elementary school level. Given the technological advancements, the choice to incorporate technology into teaching becomes crucial for enhancing student creativity. DEL activity contributes to an increase in students' digital literacy, and in terms of fluency and elaboration, students consistently demonstrate commendable performance. Consequently, the integration of DEL activities in both learning and extracurricular contexts becomes highly significant. However, it is important to acknowledge several limitations in this study. The initial abilities of teachers were not controlled, and the introduction of DEL may have influenced the enhancement of their pedagogical skills during discussions. Furthermore, the study focused on higher-class students, emphasizing the need to extend the application of DEL to lower-class students.

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