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Influence of Web Based Digital Media on Citizenship Literacy of Informatics Engineering Students

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Abstract
The study aims to analyze the influence of the use of web-based digital learning media on increasing the citizenship literacy of Informatics Engineering students. Civic literacy is understood as a multidimensional competence that includes cognitive, affective, and participatory aspects in the life of the nation and state. The research method used a quantitative approach with a quasi-experimental design of a non-equivalent control group design. The study sample consisted of 58 students, divided into experimental (n=28) and control (n=30) groups. The experimental group received web-based learning over six meetings via a digital platform, while the control group followed conventional learning. The results of the analysis using the t-test showed a significant difference between the experimental group and the control group on the post-citizenship literacy test score ($p < 0.001$), with an effect size (Cohen's d) of 1.64 which showed a large influence. These findings suggest that web-based learning is effective in strengthening students' understanding and engagement with civic values. The implications of this study emphasize the importance of developing digital media in Citizenship learning to create a generation of critical, ethical, and participatory digital citizens.

Keywords
citizenship literacy; digital media; informatics engineering; web based learning

INTRODUCTION

In the current era of digital transformation, higher education is required to continue to innovate in learning methods to adapt to the characteristics of the generation of students who were born and grew up in the information technology ecosystem (Martínez-Bravo et al., 2022). The shift in the educational paradigm from conventional to digital not only includes the technical aspects of teaching, but also touches on the substance of learning

that integrates national values with technological advances (Çetin, 2021). In this context, web-based learning is a very relevant alternative to increase the effectiveness of the learning process, including in Civic Education (Citizenship) courses which have often been considered rigid and normative (Chen et al., 2021; Lauricella et al., 2020). Students of the informatics engineering study program, as part of the digital native community, have great potential in utilizing learning technology as a means of internalizing civic values in a more dynamic and contextual manner.

Citizenship Education has a strategic role in shaping the character, national awareness, and social responsibility of students as active and democratic citizens (Tapingkae et al., 2020). However, various studies show that students' interest and involvement in Citizenship learning tend to be low, especially in study programs such as engineering and informatics (Fernández-Prados et al., 2021). This is due to the lack of an adaptive pedagogical approach to the learning style of engineering students that is more visual, applicative, and project-based. Therefore, it is important to design learning media that suits their learning preferences, one of which is by implementing web-based digital learning media.

Web-based digital learning media not only presents information in text format, but also allows for the integration of multimedia, simulation, interactivity, and problem-based learning. This type of learning supports the concept of constructivism, where students not only passively receive knowledge, but also actively build understanding through exploration, discussion, and reflection. In the context of civic education, web-based media can be designed to present actual issues, real cases in society, and involve students in online discussions, national forums, and digital campaigns that are loaded with Pancasila and democratic values.

The civic literacy that is the focus of this research includes cognitive aspects (civic knowledge), affective (attitude towards the state and society), and behavior (active participation in socio-political life) (Akcil & Bastas, 2020; Rizal et al., 2025). Conventional learning often only touches on the aspect of knowledge without encouraging real action. With web-based digital learning media, students can be involved in various activities that integrate these three aspects simultaneously, such as the creation of digital content about citizens' rights and obligations, anti-hoax campaigns, or discussion forums

on constitutional issues. This allows for learning that not only understands, but also internalizes and applies civic values in digital and real life (Martzoukou et al., 2020).

Informatics engineering students have a high tendency towards technology use, problem-solving, and application-based projects (Martzoukou et al., 2020). This characteristic can be used positively in strengthening civic literacy if facilitated through appropriate learning media. Learning approaches that emphasize active engagement and digital practices, such as the task of creating a simple constitution-themed application, online election simulations, or web-based educational content production, can be an effective strategy in transforming Citizenship materials into more contextual and meaningful for informatics students (Jackman et al., 2021; Johnston, 2020).

Several previous studies have shown the effectiveness of technology in supporting citizenship learning. A study by Choi & Cristol (2021) found that the use of digital literacy significantly improves students' understanding of the concept of democracy. Meanwhile, research from (Prasetiyo et al., 2023) shows that the integration of interactive videos in Pancasila learning can encourage critical attitudes and tolerance. In addition, a study from Puspita Dewi et al (2023) noted that web-based learning can strengthen student learning motivation, but has not explicitly measured the aspect of civic literacy as a learning outcome. On the other hand, most of the research conducted still focuses on social science or education programs, and not many have examined specifically how web-based media impacts engineering students, especially in the context of internalizing civic values.

This research gap shows that there is still limited empirical evidence on the influence of web-based digital learning on civic literacy in informatics engineering students. In fact, this group is actually at the forefront of the development of information technology and has an important role as active digital citizens. Thus, it is important to quantitatively test whether a web-based learning approach is able to improve civic understanding, attitudes, and engagement in informatics engineering students. This study is not only academically relevant, but also practical urgency in forming citizens who are technologically capable as well as with national character.

Based on this background, this study aims to analyze the influence of the use of web-based digital learning media on increasing the citizenship literacy of students of the Informatics Engineering study program. The main focus of the research is to measure the effectiveness of digital media in improving student understanding, attitudes, and

engagement in civic issues. Using a quantitative approach and pseudo-experimental design, this study will provide empirical evidence on the importance of transforming Citizenship learning towards a more relevant and transformative digital format in the era of the industrial revolution 4.0 and society 5.0.

METHOD

This study uses a quantitative approach with a quasi-experimental design of the non-equivalent control group design. This design was used to test the influence of the use of web-based digital learning media on improving the citizenship literacy of Informatics Engineering students. Since the assignment of subjects into the experimental and control groups was not done randomly, this design was chosen to still allow for causal relationship testing taking into account the limitations of field conditions.

Research Subject and Location

The research was carried out in the Informatics Engineering Study Program at Nugroho Doctoral University, Magetan, Indonesia. The research subjects consist of third-semester students who are taking Pancasila and Citizenship Education courses. The sample selection technique was carried out purposively, based on the availability of digital access, readiness to participate in online learning, and willingness to participate in research. The total number of participants was 58 students, who were divided into two groups: 28 students in the experimental group and 30 students in the control group.

Research Design

This study used a pre-test and post-test model in two unequal groups. The experimental group received treatment in the form of learning using web-based digital media, while the control group received conventional learning. To measure changes in citizenship literacy, pre-tests and post-tests were given to both groups using the same instrument.

Table 1. Quasi-Experimental Design

Group	Pre-Test	Treatment	Post-Test
Experiment (n=28)	O_1	Web-Based Learning (digital)	O_2
Control (n=30)	O_1	Conventional Learning (without web media)	O_2

Information: 1) O_1 = Citizenship literacy pre-test; O_2 = Post-test citizenship literacy

Research Instruments

The main instrument in this study is the citizenship literacy questionnaire This questionnaire is designed to measure three main dimensions of citizenship literacy: 1) Cognitive, covering knowledge about rights, obligations, constitution, and democracy. 2) Affective, reflecting attitudes towards national values, diversity, and tolerance. 3) Participatory, reflecting the readiness of students to be actively involved in civic issues, both in real life and in the digital space.

The questionnaire consists of 30 statements arranged in the form of a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). Before use, this instrument has been validated through the following process: 1) Validity of the content, tested by three experts in the field of Civic Education and educational technology. 2) Validity of the construct, tested using item-total correlation, with results showing that all items are valid ($r > 0.30$). 3) Reliability, tested using Alpha Cronbach and yielded a value of $\alpha = 0.89$, indicating a very high level of internal consistency.

Data Collection

Data collection is carried out in three main stages. The first stage is a pre-test, where a questionnaire is given to all participants before the treatment begins to measure the initial level of citizenship literacy. The second stage is the administration of treatment to the experimental group. The experimental group participated in learning for 6 meetings using the Google Classroom platform, which contained digital materials in the form of interactive learning videos, thematic articles, online discussion forums, and digital tasks such as multimedia content-based citizenship campaigns. Meanwhile, the control group followed conventional Citizenship learning in a limited face-to-face or online format, using power points, lectures, and written assignments without interactive digital elements. The third stage is the post-test, where the same questionnaire is given again to measure changes in the level of citizenship literacy in both groups.

Data Analysis

The data of pre-test and post-test results were analyzed using descriptive and inferential statistical approaches. Descriptive analysis was used to determine the distribution of scores, averages, and standard deviations in each group. Inferential analysis

is carried out through several stages as follows: 1) Normality and Homogeneity Test to ensure that the data meets the requirements of parametric analysis. 2) Independent Samples t-test to test the significant difference between the results of the post-test of the experimental and control groups. 3) Effect Size Test to find out the extent of the influence of treatment on improving citizenship literacy. All data were processed using the latest version of SPSS software, with a significance level set at $\alpha = 0.05$. The results of the analysis were used to interpret the influence of web-based digital learning media on improving the citizenship literacy of Informatics Engineering students.

RESULT AND DISCUSSION

RESULT

This study aims to determine the effect of the use of web-based digital learning media on increasing the citizenship literacy of students of the Informatics Engineering study program. The analysis of the results was presented in descriptive and inferential form, including pre-test and post-test scores in the experimental and control groups, as well as statistical tests on the differences in results between the two groups.

Description of Pre-test and Post-test Results

Before the treatment was given, all participants from both groups (experimental and control) took a pre-test to measure the level of initial citizenship literacy. The results of the pre-test showed that the two groups had relatively comparable levels of citizenship literacy. After treatment, namely learning with web-based digital media in the experimental group and conventional learning in the control group, re-measurements were carried out through post-tests to determine the changes that occurred.

Table 2. Average Pre-test and Post-test Scores

Group	N	Pre-test		Post-test	
		Mean	Standard Deviation	Mean	Standard Deviation
Eksperimen	28	68,21	5,45	83,89	4,73
Control	30	67,93	6,01	75,13	5,90

From the table above, it can be seen that the average post-test score in the experimental group increased significantly from before (68.21 to 83.89), while in the control group there was also an increase, but on a smaller scale (67.93 to 75.13). This indicates the positive influence of web-based learning treatment on improving civic

literacy. The average score increase in the experimental group reached an increase of 15.68 points, while the control group only experienced an increase of 7.20 points. In addition, the standard deviation in the post-treatment experimental group also decreased, indicating that learning outcomes were more consistent and more evenly distributed among students.

Inferential Statistical Tests

To test whether the difference between the experimental and control groups was statistically significant, independent samples were t-tested on post-test scores. Before the t-test is carried out, a test of normality and homogeneity assumptions is first carried out. The Kolmogorov–Smirnov test showed that the data from both groups were normally distributed ($p > 0.05$). Levene's test yielded a value of $p = 0.378$ ($p > 0.05$), which means variance between homogeneous groups. Thus, the data are eligible for parametric analysis using a t-test. The results of the t-test on the post-test score are presented in the following table 3:

Table 3. T-test Results Post-test Score

Variabel	t	df	Sig. (2-tailed)
Citizenship Literacy	5,921	56	0,000

The results of the analysis showed that there was a significant difference between the post-test scores of the experimental group and the control group ($p < 0.001$). A high t-value (5,921) indicated that the increase in civic literacy in the experimental group was statistically superior to that of the control group. In other words, the use of web-based digital learning media has a significant positive effect on improving the citizenship literacy of Informatics Engineering students.

In addition to statistical significance, this study also measured the effect size of the treatment using Cohen's formula d, which is calculated based on the mean difference of the post-test divided by the combined deviation. Cohen's value $d = 1.64$ is included in the category of large effect according to Cohen's (1988) interpretation, which means that the use of web-based digital learning media has a very strong impact on improving students' citizenship literacy.

DISCUSSION

The results of this study show that web-based digital learning media has a significant influence on increasing the citizenship literacy of students of the Informatics Engineering study program. The experimental group that followed learning with a digital approach showed a higher average increase in literacy scores than the control group that studied conventionally. The difference in post-test average scores of more than 8 points as well as the effectiveness score (Cohen's d = 1.64) which is in the large category, provide strong evidence that learning approaches that utilize technology are not only relevant, but also very effective in the context of value-based civic education (Tapingkae et al., 2020; Widiyanto, 2021).

Conceptually, these findings corroborate Vygotsky's theory of social constructivism, which states that meaningful learning occurs through social interaction, real context, and active involvement of learners (Saing & Santoso, 2023). In the web-based learning media design applied in this study, students not only receive information, but also engage in collaborative, exploratory, and reflective activities such as online discussion forums, digital campaign assignments, and interactive quizzes. This approach allows students to experience a learning process that not only strengthens cognitive aspects, but also affective and participatory aspects, as defined in the framework of civic literacy (Nababan et al., 2023; Puspita Dewi et al., 2023).

In terms of the profile of informatics engineering students, the web-based approach is proven to be in accordance with the characteristics of those who prefer technology-based activities, systematic thinking, and flexible and independent learning access. While conventional approaches are often ineffective in building interest in normative materials such as Citizenship, the use of digital media actually makes learning feel relevant, applicative, and related to their daily lives as digital natives (Nababan et al., 2023). This strengthens the argument that digital media is not just an instructional innovation, but also a pedagogical strategy that is able to bridge the distance between value content and the real world of students (Al-Hasan et al., 2020; Alenezi, 2023).

In terms of the use of participatory citizenship literacy instruments, it provides a more complete picture of student development as citizens (Akcil & Bastas, 2020; Rizal et al., 2025). An increase in scores is not only seen in understanding concepts, but also in attitude and readiness to act. In this context, civic literacy is no longer enough to include

memorizing Pancasila and the 1945 Constitution, but also includes how students understand and behave towards hoaxes, hate speech, digital political polarization, and online communication ethics (Patrick et al., 2023). Web-based learning in this study provides a space for students to test these attitudes and values in a more real and current context.

The implications of the results of this study are quite broad for Citizenship lecturers, these results provide an empirical basis for systematically integrating digital technology into the learning process, especially when teaching in exact or Engineering study programs (Prasetiyo et al., 2023). The Ministry of Education and higher education institutions can also consider developing a technology-based Citizenship curriculum that is more adaptive to the context of the current generation of students (Martzoukou et al., 2022; Möllers, 2021). Not only as a form of learning modernization, but as a transformative strategy to ensure that national values remain alive in the midst of a digital era full of identity challenges and polarization.

Web-based citizenship learning has great potential to shape digital citizens who are value-aware, think critically, and act ethically. In a higher education ecosystem that is increasingly moving towards digitalization, strengthening civic literacy through technology-based approaches is not only important, but urgent. Therefore, the development and implementation of digital media based on Pancasila values must be an integral part of civic education reform in the future. This research provides the initial foundation for this direction and opens up opportunities for broader and more in-depth follow-up research.

CONCLUSION

The use of web-based digital learning media has a significant and effective influence in improving the citizenship literacy of students of the Informatics Engineering study program. Web-based learning is able to facilitate students to understand citizenship concepts in a more contextual way, internalize national values through interactive learning experiences, and form attitudes and active participation as responsible digital citizens. These findings show that Citizenship learning tailored to the characteristics and technological preferences of engineering students not only allows for simultaneous improvement of cognitive aspects, but also affective and participatory aspects. Therefore,

it is recommended that teachers and higher education institutions integrate digital learning media into the Citizenship Education curriculum more systematically, especially in non-social study programs such as engineering and informatics. In addition, the development of digital media should not only focus on the visual appearance aspect, but also prioritize the substance of values and encourage student involvement in actual socio-political issues. However, this study has limitations on the relatively small number of samples and the limited scope of one study program and institution, so the results cannot be generalized widely. Therefore, further research is recommended to involve a larger and more diverse sample, as well as use a mixed-method approach to gain a deeper understanding of the dynamics of citizenship learning in the digital age.

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