



# Digital Literacy through a Web-Based Application: Addressing Polarization and Promoting Social Integration among Islamic Senior High School Students

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## ABSTRACT

Digital literacy encompasses not only technical skills but also an understanding of social dynamics such as polarization and the need for social integration in digital environments. This study aims to examine the effectiveness of a web-based Mobile Polarization and Social Integration application in improving students' digital literacy. A quasi-experimental design with a control group was employed, involving students from an Islamic senior high school. Data were collected using a validated test and analyzed through comparative statistical methods. The application significantly enhances students' digital literacy and supports their awareness of polarization and social integration. This study highlights the potential of web-based learning applications to strengthen digital citizenship and encourage responsible and inclusive participation in digital spaces.

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## 1. INTRODUCTION

The increased utilization of the internet and digital media has provided a platform that facilitates the enhancement of individual capabilities for learning, socializing, and engaging in political life [1, 2]. The current educational paradigm must integrate innovative technologies and the utilization of digital devices into the teaching process [3]. This integration is crucial for equipping students with the knowledge and skills necessary to thrive in an ever-evolving digital environment [4].

In an era where information is readily accessible and technology permeates every aspect of life, digital literacy has become paramount. Digital literacy encompasses the ability to access, evaluate, produce, and share information critically through the use of computers, mobile devices, and the internet [5].

The current development of the internet has transformed communication patterns from a unidirectional nature, predominantly mediated by government or political elites, to a more interactive, bidirectional interaction. This transformation enables individuals not only to receive information but also to create and disseminate it, thereby allowing them to become more autonomous in the use, management, and distribution of information [6]. Consequently, strengthening digital literacy must be a priority in educational curricula.

Digital literacy refers to the abilities and skills that students require to effectively utilize and benefit from digital technologies, including the use of digital resources [7]. Trends in educational research and digital literacy indicate that digital education extends beyond merely becoming more adept technology users; it also encompasses understanding how individuals acquire, search for, and employ information, and serves as an effort to enhance critical thinking skills and media literacy [7, 8]. However, current concerns regarding the digital divide pertain not only to the availability of devices or internet access but also necessitate consideration of digital literacy as an individual's capacity to engage with digital media meaningfully and responsibly within social practices.

This emphasis is crucial due to the extensive exposure to political discussions in digital media, which highlights the importance of strengthening digital literacy not only in terms of enhancing students' skills to evaluate online content, operational skills, navigating information, and understanding technical features of digital platforms [9, 10], but also in recognizing its development as knowledge about the role of the internet in relation to broader socio-political and economic power dynamics [11].

In its development, digital media and the internet not only provide various information and perspectives to users but also offer individuals the opportunity to express themselves through sharing activities and commenting on posts they encounter. Users can respond to content that may align or not align with their own views on a particular issue [12]. If users possess awareness and a tolerant attitude towards other viewpoints, the likelihood of polarization is significantly low [13].

Conversely, when users are exposed to opposing perspectives, this can trigger counterarguments and polarized attitudes [14]. The social polarization that arises can be observed through the division of society into groups with markedly different views or ideologies, often in extreme opposition [15]. The issue of polarization in Indonesia tends to increase during elections, with each political issue raised in cyberspace likely to incite prolonged conflict and have the potential to divide society [16, 17].

The causes of polarization typically arise from several factors, including:

- (i) Filter bubble: Social media algorithms that present content according to user preferences, thereby limiting users to information that aligns with their views [18, 19].
- (ii) Echo chamber: Users tend to interact with groups sharing similar viewpoints, which reinforces their beliefs without exposing them to differing perspectives [20-22].
- (iii) The spread of hoaxes and misinformation: False information disseminated with the intention of influencing public opinion and reinforcing disparities in viewpoints [23, 24].
- (iv) Provocation and hate speech: Provocative comments that exacerbate differences of opinion, thereby leading to social conflict [25].

The effects of social polarization can result in social fragmentation, where society is divided into several conflicting groups, a decline in tolerance, a reduction in mutual respect for differing opinions, and the potential for both verbal and physical conflicts triggered by sharp differences in viewpoints.

In addition to the polarization caused by the lack of digital literacy, effective digital literacy can have a positive impact on social integration. Social integration is the process of uniting different social groups into a harmonious and inclusive society [26]. The factors that support social integration in digital media include:

- (i) Cross-cultural interaction: Social media facilitates interactions between groups from different cultural backgrounds, allowing for mutual recognition and understanding;
- (ii) Positive online communities: Groups and online communities that discuss common interests or issues can connect individuals from diverse backgrounds;
- (iii) The dissemination of tolerance values: Digital campaigns that promote tolerance, inclusion, and peace; and
- (iv) Social collaboration: Utilizing digital media for social actions that involve various groups within society [27].

Digital literacy plays a crucial role in reducing social polarization and fostering social integration. With proficient digital literacy skills, members of society can not only wisely utilize technology but also establish more inclusive and harmonious communication in the digital age.

In the field of education, the development of digital literacy skills has been addressed by several studies, including the utilization of learning media, the creation of digital projects, digital demonstrations, the introduction of digital-based products, and the recognition of the advancements in digitalization in everyday life [28, 29].

The types of learning media employed to enhance digital literacy must be aligned with the technological advancements continuously utilized by students [30]. Currently, the use of web-based applications has become a readily accessible medium for students in the learning process [31]. The use of gadgets has become a fundamental necessity in the educational domain, thus necessitating that the gadgets used by students be purposefully selected to enhance skills and support the learning process [32].

Web-based application learning to develop students' digital literacy has been extensively examined within the contexts of subjects such as science, mathematics, and health education. However, research in the field of digital citizenship education remains limited. The objective of digital citizenship education is to train students to become responsible digital citizens who respect others and are capable of expressing themselves healthily and appropriately. For

instance, prior research has demonstrated that the development of web-based learning models can support the design of effective educational programs [33]. Furthermore, studies indicate that web-based learning models supported by collaborative reading annotation systems can enhance students' information literacy and critical thinking skills [34]. Other research reveals that the development of smartphone applications can improve children's safer internet usage habits and digital literacy through interactive features that are engaging, such as videos and texts that teach safe online behaviors [35]. Additionally, further studies have shown that web-based games that incorporate animation, background music, and sound effects can assist students in understanding digital ethics and reinforce responsible online behavior [36]. Moreover, the creation of mobile game prototypes as educational tools has been proven effective in aiding students to protect themselves from phishing attacks and in enhancing their digital security literacy [37].

In the context of chemistry education, research indicates that web-based learning can improve the learning outcomes of high school students [38], while in the health sector, web-based tools are effective in enhancing medical students' skills in recognizing, evaluating the quality of information, and combating misinformation [39].

Thus, although numerous studies have demonstrated the effectiveness of utilizing web applications for the enhancement of literacy across various domains, there remains significant potential for further development and investigation in the field of digital citizenship education. Based on the identified issues and several findings, this research aims to improve the digital literacy of students in Madrasah Aliyah by employing the developed MPIS application. A novel aspect of this study is the creation of a web-based application called the MPIS Application, designed as a resource for educators to facilitate teaching and enhance students' digital literacy.

The MPIS application is developed by the research team as a demonstration of commitment to supporting learning, enabling students to instill an understanding of the importance of digital literacy. This application possesses unique features that differentiate it from other digital literacy initiatives, specifically in its comprehensive coverage of digital literacy content, polarization, and social integration, which are explored in greater depth along with inquiries related to digital literacy skills.

## 2. METHODS

This study employed a quasi-experimental design utilizing a pre-test and post-test framework with a non-equivalent control group. The research design is presented in **Table 1**. **Table 1** illustrates that this study compares two groups: the Experimental Group, which utilizes the MPIS App as a digital learning medium, and the Control Group, which employs conventional learning media, specifically through the reading of printed texts.

**Table 1.** The research design.

GROUP	PRE-TREATMENT	TREATMENT	POST-TREATMENT
Experiment	L	X <sub>1</sub>	L
Control	L	X <sub>2</sub>	L

Note: L is the questions regarding the understanding of digital literacy, X<sub>1</sub> is the use of the MPIS app, and X<sub>2</sub> is the conventional

The research sample comprised 64 students, who were chosen through a cluster random sampling method from a total population of 150 students at MA Simaniskin, located in Bandung City. The instrument employed for evaluating digital literacy was a validated multiple-choice test consisting of 20 items. Data collection occurred through pre-tests and post-tests to evaluate the alterations in students' digital literacy scores. Data analysis involves descriptive methods for digital data literacy and independent t-tests to compare the MPIS Application Media with conventional Media. Before hypothesis testing, normality tests were conducted using the Kolmogorov-Smirnov method, and homogeneity was assessed through Levene's Test.

To measure the level of improvement in digital literacy, this study employs the *N-Gain* Score (**Equation (1)**).

$$N - gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \times 100\% \quad (1)$$

where *S<sub>post</sub>* is the final score (post-test), *S<sub>pre</sub>* is the initial score (pre-test), and *S<sub>max</sub>* is the maximum score.

The enhancement of students' digital literacy was derived from the N-gain scores (Equation 2), which are categorized into three levels: high ( $g > 0.7$  or 70%), moderate ( $0.3 \leq g \leq 0.7$  or 70%), and low ( $g < 0.3$  or 30%). The improvement of digital literacy, classified according to N-gain scores as high, medium, or low, was determined utilizing Microsoft Excel 2021 and SPSS 26.

With this research design, the results obtained can indicate whether the utilization of the MPIS App is significantly more effective than conventional methods in enhancing students' digital literacy.

### 3. RESULTS AND DISCUSSION

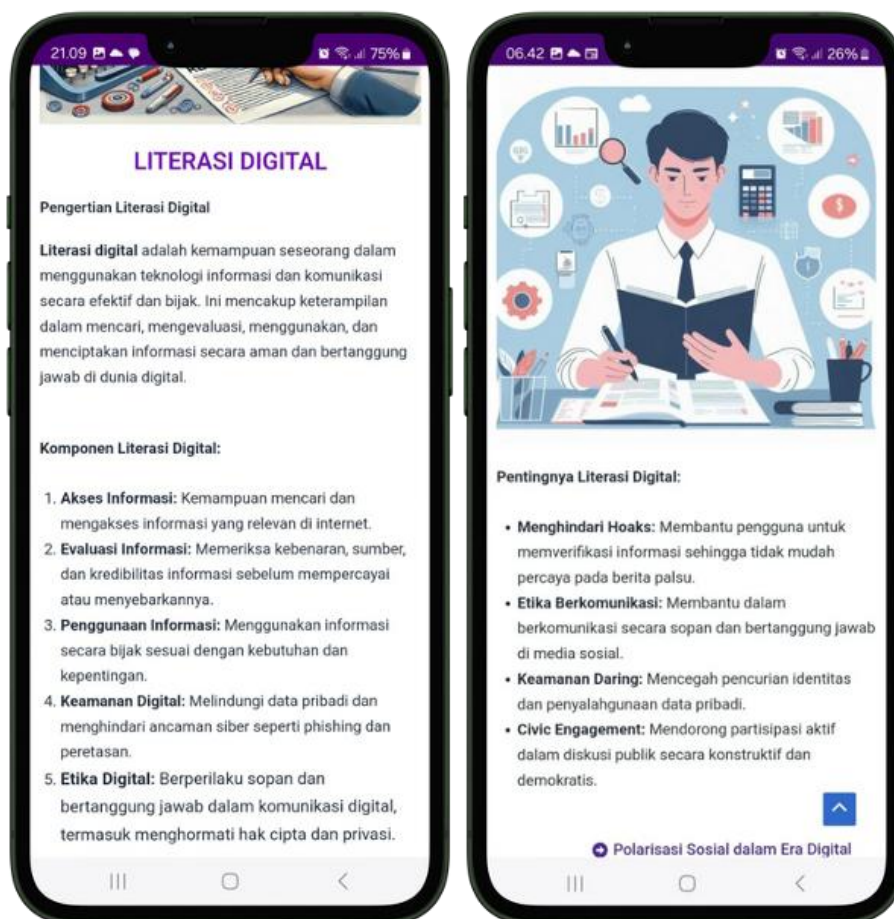
In this section, we discussed the MPIS App used in learning control classes or conventional media, and proved the results and data about the results showed that there was an increase and influence on digital literacy using the MPIS App. The MPIS application is a web-based application that can be accessed via Android mobile devices, with the logo presented as depicted in **Figure 1**. This logo shows the important role of digital literacy in selecting and sorting information or using digitized goods.



**Figure 1.** MPIS app logo.

The MPIS Application is structured into five principal sections, aimed at advancing students' digital literacy. The initial section offers a foundational comprehension of digital literacy, as exemplified in **Figure 2**.

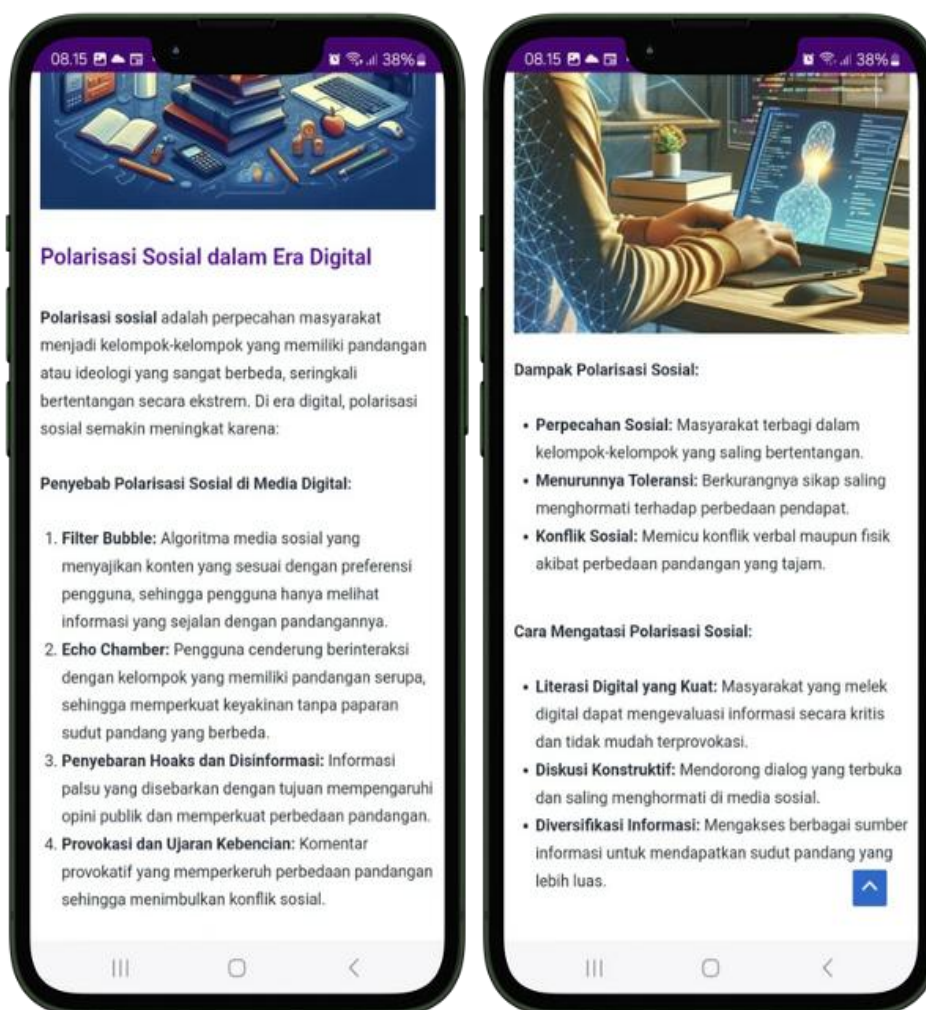
**Figure 2** illustrates the digital literacy materials accessible to students. In part (a) of the figure, the content pertains to the significance of students' abilities to access, evaluate, and utilize information, as well as the aspects of digital security and ethics. Part (b) of the figure presents the importance of digital literacy in enabling students to avoid misinformation, apply ethical communication practices, ensure online safety, and encourage active participation as digital citizens.



**Figure 2.** Presentation of digital literacy resources within the MPIS App.

The second section highlights social polarization in the digital era, which requires understanding from students, as illustrated in **Figure 3**. **Figure 3** illustrates the topic of social polarization that is accessible to students. In part (a) of the figure, information is presented to students regarding the potential for societal division into groups with differing viewpoints, highlighting the causes of polarization in digital media, such as filter bubbles, echo chambers, the dissemination of hoaxes and misinformation, as well as provocation and hate speech. In part (b) of the figure, the consequences of polarization are depicted, including division, decreased tolerance, and social conflict.

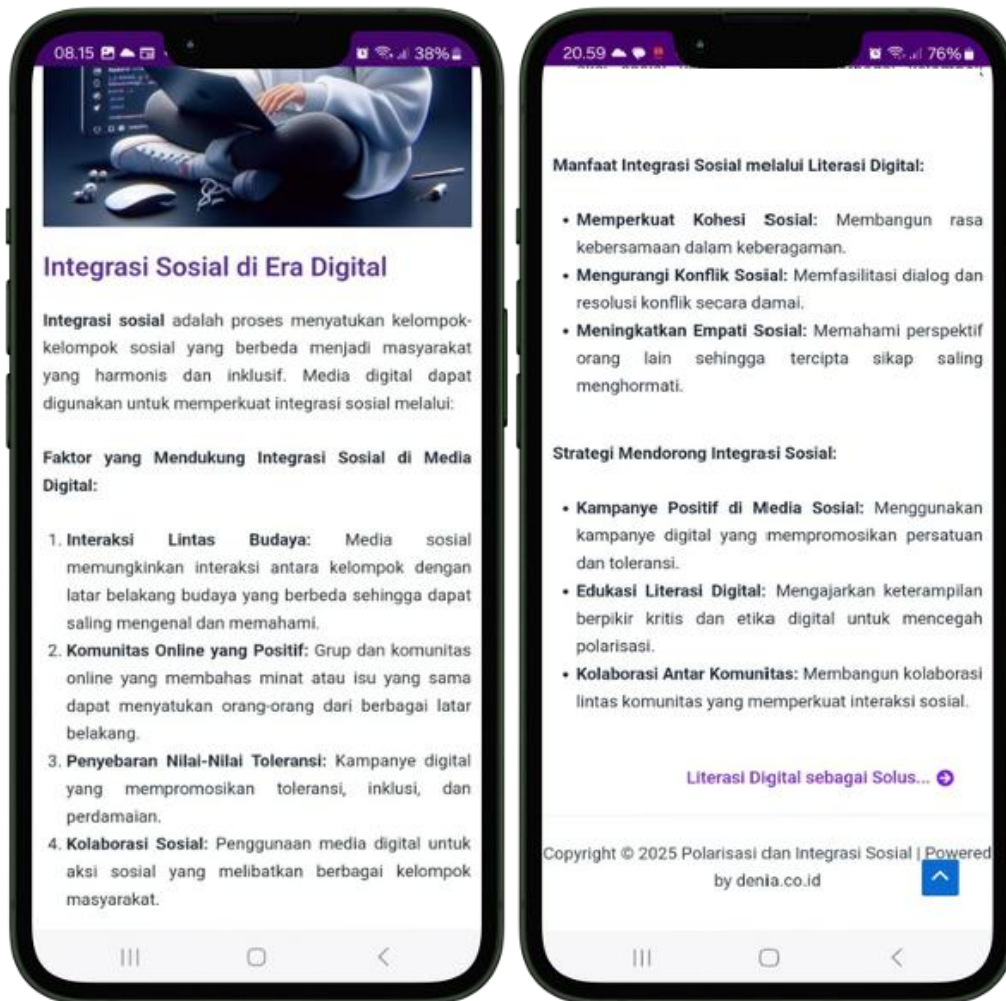
Additionally, students are equipped with knowledge about strategies to address polarization, which includes the importance of strong digital literacy, the enhancement of constructive discussions, and the diversification of information.



**Figure 3.** Display of social integration materials in the digital era on the MPIS app.

The third section presents material concerning social integration in the digital era. **Figure 4** illustrates the materials related to social integration in the digital era that can be accessed by students. In section (a), this figure presents information to students regarding the concept or definition of social integration in the digital era, as well as the factors that support social integration in digital media. In section (b), the materials concerning the benefits of social integration and strategies to promote social integration are displayed.

In the fourth section, the content of the MPIS App presents students with material concerning digital literacy as a solution to polarization and a promoter of social integration. **Figure 5** illustrates the components of effective digital literacy, equipping students with the skills to verify information, communicate ethically, access diverse perspectives, and utilize social media positively. Lastly, there is a conclusion that discusses the role of digital literacy in mitigating social polarization and promoting social integration. The content of the MPIS App media includes multiple-choice evaluation questions as illustrated in **Figure 6**.



**Figure 4.** Presentation of social integration material in the digital era on the MPIS app.

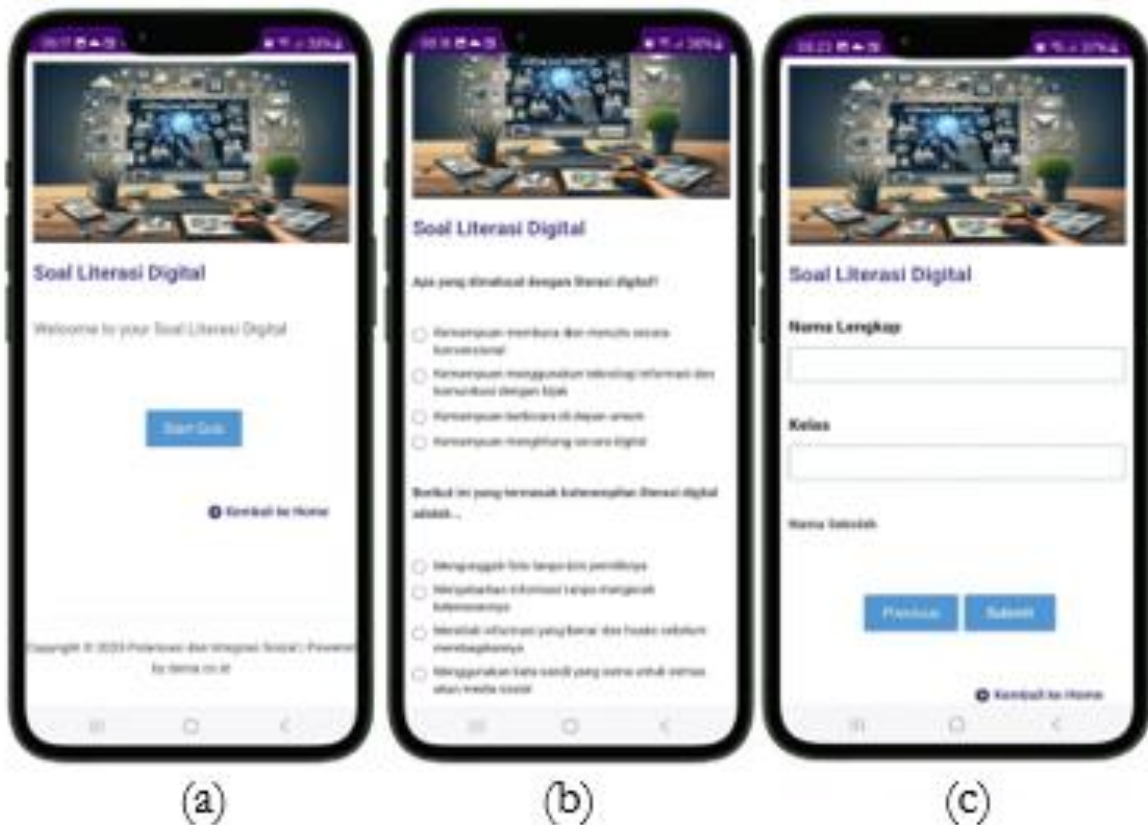
To evaluate the effectiveness of the MPIS App, this study compares pre-test and post-test scores, as well as calculates the N-gain value to measure the impact of using the MPIS app on students' digital literacy. The following presents the results obtained based on the data analysis in **Table 2**, which provides data regarding students' digital literacy scores. The average scores of students increased significantly from the pre-test (35) to the post-test (85), indicating the effectiveness of utilizing the MPIS App media. The minimum and maximum scores also showed improvement, which demonstrates that all students experienced gains in their digital literacy. The N-gain value of 0.75 reflects a high increase in students' understanding of digital literacy following the use of the MPIS App learning media. Furthermore, the standard deviation decreased from 10.14 in the pre-test to 7.20 in the post-test, indicating a reduction in score variation among students, which implies a more equitable learning outcome. This suggests that the use of the MPIS App media has a significant positive impact on enhancing students' digital literacy.



**Figure 5.** The display of digital literacy materials as a solution to polarization and a catalyst for social integration in the MPIS app.

Subsequently, to ascertain the comparative average scores of students' digital literacy between the use of the MPIS app as a learning medium and conventional learning media, three categories of measurement were employed, namely (i) Pre-test, (ii) Post-test, and (iii) N-gain. **Figure 7** illustrates that prior to instruction, the pre-test mapping in the class utilizing the MPIS App media indicated an average score of 35, while the class employing conventional media showed an average score of 25. The initial scores of both groups were still considered low, although the MPIS App Class had a slightly higher score.

Following the instructional period, the post-test results revealed an improvement in scores for both groups; however, students utilizing the MPIS App achieved an average score of 85, surpassing the average score of 70 attained by the group using conventional media. The N-Gain results indicate a significant difference in improvement between the two media applications (75 vs 45%), suggesting that the MPIS App media is more effective and provides a more optimal learning impact in enhancing students' digital literacy compared to conventional teaching media.



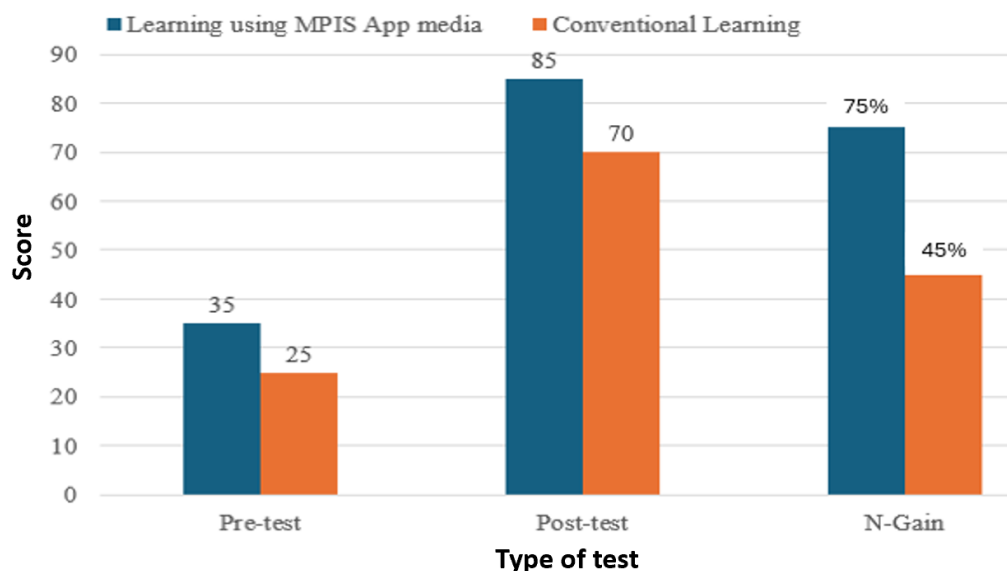
**Figure 6.** (a) The digital literacy question, where students can click 'start' to begin working on the social studies tasks. (b) tasks for students with answering a multiple-choice questionnaire consisting of 20 questions. (c) The column displaying the process for students to submit their answers after completing the questions, which requires them to fill in their personal information, including their name, class, and school origin.

**Table 2.** Description of students' digital literacy.

STAGES	N	VALUE			
		MIN	MAX	MEAN	STDEV
Pre-test	32	20	50	35	10.14
Post-Test	32	80	90	85	7.20
N-gain	32	0.65	0.91	0.75	0.05

Subsequently, the Kolmogorov-Smirnov test is employed to evaluate whether the obtained data adhere to a normal distribution. If the test results indicate a p-value greater than 0.05, the data is considered to be normally distributed, which is essential as a prerequisite for the application of parametric statistical tests. The results of the normality test for the pre-test and post-test data regarding students' digital literacy, using the Kolmogorov-Smirnov test, are presented in **Table 3**. This table illustrates the data collected from 64 students during the pre-test and post-test phases, indicating that all participants were assessed in both stages. The results of the normality parameter analysis reveal a significant increase in the average score for digital literacy, rising from 30.0 in the pre-test to 77.5 in the post-test following the use of the MPIS App as a learning medium. The standard deviation in the pre-test was 12.1055, while it increased to 14.89221 in the post-test. This increase in standard deviation indicates that

there was a greater variation in student scores post-instruction. The results of the normality test for the pre-test and post-test data indicated a pre-test p-value of 0.218 and a post-test p-value of 0.081, which demonstrates that the data on student digital literacy is normally distributed and exhibits homogeneous variances ( $P > 0.05$ ).



**Figure 7.** Comparison of the mean score of pre-test, post-test, and n-gain of student literacy in the digital MPIS app class with the conventional class.

**Table 3.** One-sample Kolmogorov-Smirnov test of digital literacy data.

		PRE-TEST OF LITERACY DIGITAL	POST-TEST OF LITERACY DIGITAL	
N		64	64	
Normal Parameters <sup>a,b</sup>	Mean	30.0	77.5	
	Std. Deviation	12.10555	14.89221	
Most Extreme Differences	Absolute	0.121	0.186	
	Positive	0.142	0.089	
	Negative	-0.130	-0.198	
Test Statistics		0.130	0.198	
Asymp. Sig. (2-tailed)		0.018 <sup>c</sup>	0.000 <sup>c</sup>	
Monte Carlo Sig. (2-tailed)	Sig.	0.218 <sup>d</sup>	0.081 <sup>d</sup>	
	95% Confidence Interval	Lower Bound	0.192	0.006
		Upper Bound	0.423	0.165

Note: A test distribution is Normal.

After the results of the normality test indicate that the data are normally distributed, further analysis is conducted using parametric statistical tests. Therefore, the digital literacy data of the students can be assessed using independent t-tests to determine whether the use

of the MPIS App significantly impacts the enhancement of digital literacy compared to conventional learning methods. **Table 4** illustrates a significant difference in the improvement of digital literacy between the group utilizing the MPIS App and the group employing conventional media. The MPIS App has proven to be more effective in enhancing digital literacy, with an average difference of 20.587 points higher compared to conventional media. The assumption of homogeneity of variances is satisfied (Sig. Levene = 0.202 > 0.05), allowing the t-test results to be interpreted under the assumption of equal variances. The Sig. (2-tailed) value of 0.000 indicates that this difference is highly statistically significant and not attributable to chance.

**Table 4.** Independent samples test of digital literacy.

EQUAL VARIANCE	F	SIG.	T	DF	SIG. (2-TAILED)	MEAN DIFFERENCE	STD. ERROR DIFFERENCES	95% CONFIDENCE INTERVAL OF THE DIFFERENCE	
Assumed	1.675	0.202	6.523	62	0.000	20.587	3.102	14.567	28.765
Not-assumed.			6.865	32.156	0.000	20.587	3.102	14.232	28.654

Based on the results presented, there exists a significant difference in improvement between learning through the MPIS App and conventional learning methods that do not utilize the MPIS App. In the context of technological advancements and digital media, the development of early digital literacy experiences for students has become multimodal, necessitating the importance of mastering communication presented in various forms, including text, images, and audio, through an array of digital tools and content. Therefore, the MPIS App, as a web-based learning medium, is crucial for creating an interactive learning environment that supports the enhancement of students' digital literacy [40].

Web-facilitated learning, exemplified by the MPIS App, can improve student learning performance, task achievement levels, and educational goal attainment, as it provides direct interaction opportunities, allowing students to engage with instructional material through inputs of images, text, and touch screens. This perspective is reinforced by the characteristics of contemporary students who are part of the digital natives [41]. They have been raised and grown in an environment surrounded by digital technology and the internet [42].

A hallmark of digital natives is their preference for utilizing media and communication that incorporate visual elements such as graphics, images, or videos produced through mobile devices, as opposed to relying solely on text [41, 43, 44, 45]. This implies that visuals, such as images and graphs, are perceived as more engaging for them compared to text-based content [41].

The potential application of web-based applications (MPIS App) to enhance students' digital literacy is grounded in a sociocultural approach, which posits that learning is a process of interaction wherein practices and social artifacts, such as digital devices and content, generate a shared semiotic system for collective participation, cognitive processes, and learning [46].

Consequently, the development of web-based learning media is crucial for creating an interactive learning environment that comprehensively supports the improvement of digital literacy [41]. Contemporary understanding of literacy must encompass a diverse range of

texts and technologies [47, 48]. Therefore, in our research, we intend to investigate the potential of employing a web-based application (MPIS App) to strengthen students' digital literacy.

This indicates that the role of learning media is significantly important as a support for education; furthermore, selecting appropriate media must be conducted in accordance with the learning objectives [49]. Based on the findings obtained, the significance of digital literacy in citizenship education can enhance students' understanding of the effects of polarization and social integration, which contribute to their development of virtuous character as citizens who can wisely navigate the digital era [50].

The digital literacy that students acquire serves as a foundation for character development in life, facilitating social integration, whereby they consistently maintain harmony and cooperate within the community [51]. Web-based applications focusing on Polarization and Social Integration can significantly contribute to enhancing students' awareness of ethical, social, and cultural issues associated with technology, thereby promoting lifelong learning practices.

Possessing digital literacy constitutes a fundamental component in mitigating social polarization, fostering harmonious living, and nurturing responsible citizenship [52]. Based on the resultant findings and discussions, numerous initiatives can be undertaken to further advance the development of digital-based learning media aimed at enhancing digital literacy competencies in educational contexts, particularly at the madrasah level. The MPIS App media, as developed, can be broadly applied across various disciplines to augment students' digital literacy skills, thereby facilitating character development in the face of global challenges in the digital age.

#### **4. CONCLUSION**

This research underscores the effectiveness of the MPIS App (Mobile Polarization and Social Integration) as a learning medium that significantly enhances students' digital literacy compared to the use of conventional learning media. The average score increased from 35 in the pre-test to 85 in the post-test, with an N-gain value of 0.75 indicating a substantial improvement in students' digital literacy. Furthermore, the reduction in standard deviation from 10.14 in the pre-test to 7.20 in the post-test demonstrates that the enhancement in digital literacy occurred uniformly among the students. A comparison between the group using the MPIS App and the group using conventional media also revealed superior outcomes for the MPIS App group, with post-test scores reaching 85 compared to 70 for the conventional group, as well as a significant difference in N-gain (75% versus 45%). These findings affirm that the use of technology-based learning media, such as the MPIS App, is effective in improving digital literacy and supporting the strengthening of positive civic character formation among students. This fosters students' responsibility in their engagement within the digital space, as well as their readiness to confront the challenges of polarization and social integration in the increasingly prevalent digital era.

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## 6. AUTHORS' NOTE

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