

**THE EFFECTIVENESS OF DIGITAL LITERACY PROGRAMS IN BRIDGING
THE DIGITAL DIVIDE (AN EXPERIMENTAL STUDY AT THE TENTH GRADERS
OF MAN 1 KOTA PEKALONGAN IN ACADEMIC YEAR 2025/2026)**

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ABSTRACT

The digital divide remains a significant challenge in education, as unequal digital competencies can limit students' participation in technology-supported learning. Digital literacy programs have been widely recognized as a potential strategy to reduce this gap by strengthening students' abilities to access, evaluate, create, and communicate information using digital technologies. This study aimed to examine the effectiveness of a digital literacy program in bridging the digital divide among tenth-grade students at MAN 1 Kota Pekalongan during the 2025/2026 academic year. A quasi-experimental design with a non-equivalent control group was employed involving 30 students, consisting of 15 students in the experimental group and 15 students in the control group. The experimental group participated in digital literacy activities through Google Meet, Canva, and Padlet, while the control group received conventional online instruction using the same learning materials. Data were collected through pre-test and post-test assessments and analyzed using the Shapiro–Wilk test, Levene's test, Mann–Whitney U test, and Wilcoxon signed-rank test. The Mann–Whitney U test indicated a statistically significant difference between the experimental and control groups ($U = 179.500$, $p = .005$). However, the Wilcoxon signed-rank test showed no statistically significant improvement within either the experimental group ($p = .083$) or the control group ($p = .286$). These findings suggest that the digital literacy program contributed to differences in digital literacy outcomes between the two groups, although it did not produce statistically significant improvements within the experimental group. The study highlights the potential of structured digital literacy programs as an educational approach to addressing the digital divide while emphasizing the need for longer intervention periods and broader participant samples in future research.

Keywords: Digital Literacy, Digital Divide, Digital Literacy Program

ABSTRAK

Kesenjangan digital tetap menjadi tantangan besar di bidang pendidikan, karena ketimpangan dalam kompetensi digital dapat membatasi partisipasi siswa dalam pembelajaran yang didukung teknologi. Program literasi digital telah diakui secara luas sebagai strategi potensial untuk mengurangi kesenjangan ini dengan memperkuat kemampuan siswa dalam mengakses, mengevaluasi, membuat, dan menyampaikan informasi menggunakan teknologi digital. Penelitian ini bertujuan untuk mengkaji efektivitas program literasi digital dalam menjembatani kesenjangan digital di kalangan siswa kelas X MAN 1 Kota Pekalongan pada tahun ajaran 2025/2026. Desain kuasi-eksperimental dengan kelompok kontrol yang tidak setara digunakan dalam penelitian ini, yang melibatkan 30 siswa, terdiri dari 15 siswa di

kelompok eksperimen dan 15 siswa di kelompok kontrol. Kelompok eksperimen mengikuti kegiatan literasi digital melalui Google Meet, Canva, dan Padlet, sedangkan kelompok kontrol menerima pembelajaran daring konvensional dengan menggunakan bahan ajar yang sama. Data dikumpulkan melalui penilaian pra-tes dan pasca-tes, kemudian dianalisis menggunakan uji Shapiro–Wilk, uji Levene, uji Mann–Whitney U, dan uji Wilcoxon signed-rank. Uji Mann–Whitney U menunjukkan adanya perbedaan yang signifikan secara statistik antara kelompok eksperimen dan kelompok kontrol ($U = 179,500$, $p = 0,005$). Namun, uji Wilcoxon signed-rank tidak menunjukkan adanya peningkatan yang signifikan secara statistik baik pada kelompok eksperimen ($p = 0,083$) maupun pada kelompok kontrol ($p = 0,286$). Temuan-temuan ini menunjukkan bahwa program literasi digital berkontribusi terhadap perbedaan hasil literasi digital antara kedua kelompok tersebut, meskipun program tersebut tidak menghasilkan peningkatan yang signifikan secara statistik di dalam kelompok eksperimen. Penelitian ini menyoroti potensi program literasi digital terstruktur sebagai pendekatan pendidikan untuk mengatasi kesenjangan digital, sekaligus menekankan perlunya periode intervensi yang lebih lama dan sampel peserta yang lebih luas dalam penelitian di masa mendatang.

Kata Kunci: Literasi Digital, Kesenjangan Digital, Program Literasi Digital

A. Introduction

Digital transformation has fundamentally reshaped educational practices, making digital competence an essential requirement for students in the twenty-first century. Beyond the availability of digital technologies, students are expected to access, evaluate, create, and communicate information effectively and responsibly in digital environments. Consequently, digital literacy has become a fundamental competency that supports students' participation in technology-enhanced learning and lifelong learning. The DigComp 2.2 framework conceptualizes digital literacy as a multidimensional competence encompassing

information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving, indicating that digital competence extends beyond technical skills to include critical and ethical technology use.

Despite the increasing integration of digital technologies in schools, inequalities in students' digital competencies remain a persistent educational challenge. The concept of the digital divide has evolved from disparities in physical access to technology toward differences in digital skills and the ability to benefit from digital technologies. Van Deursen and van Dijk (2019) argue

that unequal digital competencies contribute to educational inequalities even when access to digital devices and internet connectivity is relatively available. Similarly, van de Werfhorst et al. (2022) demonstrate that differences in students' digital readiness continue to create unequal learning opportunities, emphasizing that improving digital competence is an important step toward reducing educational disparities.

One strategy for addressing this challenge is the implementation of structured digital literacy programs. Such programs are designed to develop students' digital competencies through guided learning activities and the meaningful integration of digital technologies into classroom instruction. Blažič and Blažič (2020) describe digital literacy programs as structured educational interventions that foster students' ability to use digital technologies effectively, while García-Peñalvo et al. (2024) emphasize that successful digital transformation in education depends on how educational innovations are implemented within institutional contexts. Likewise, Yastıbaş and Baturay (2023) argue

that digital literacy initiatives are more effective when digital technologies are integrated into pedagogical practices rather than introduced as isolated technological tools.

Previous studies have consistently reported positive associations between digital literacy and educational participation. Siddiq et al. (2017) found that higher levels of ICT literacy were associated with stronger educational performance, while Al Mamun et al. (2022) reported that structured digital learning activities promoted learner engagement and educational inclusion. Ramadhania Novianti and Suud (2025) also demonstrated that digital literacy instruction positively influenced students' engagement and academic participation. However, most previous studies employed correlational or descriptive approaches, making it difficult to determine the effectiveness of digital literacy programs through controlled intervention. Moreover, relatively few experimental studies have examined this issue in Indonesian secondary school contexts, particularly within Islamic senior high schools (madrasahs).

To address this gap, the present study employed a quasi-experimental design to investigate the effectiveness of a Digital Literacy Program implemented with tenth-grade students at MAN 1 Kota Pekalongan. Rather than examining digital literacy as an individual characteristic alone, this study evaluated whether a structured digital literacy intervention could contribute to bridging the digital divide by comparing students who participated in the program with those who received conventional instruction. The findings are expected to provide empirical evidence regarding the implementation of digital literacy programs in secondary education and contribute to the ongoing discussion on strategies for reducing digital inequalities within school environments.

B. Method

This study employed a quantitative approach using a quasi-experimental design with a non-equivalent control group design. The design was selected because the participants were assigned to existing classes without random assignment. The study involved two groups: an experimental group and a control group. Both groups completed a pre-

test before the treatment and a post-test after the instructional period to measure students' learning outcomes.

The participants of this study were 30 eleventh-grade students at MAN 1 Kota Pekalongan, consisting of 15 students in the experimental group and 15 students in the control group. The participants were selected using purposive sampling based on the existing class organization established by the school. The experimental group received instruction through a Digital Literacy Program, while the control group received conventional online instruction.

The research instrument was an English learning achievement test administered as both a pre-test and a post-test. The test was designed to measure students' learning outcomes before and after the implementation of the Digital Literacy Program. The same instrument was administered to both groups to ensure consistency in measuring students' achievement.

The research procedure consisted of three stages: pre-test, treatment, and post-test. At the beginning of the study, both groups

completed a pre-test to determine their initial learning outcomes. During the treatment stage, the experimental group participated in learning activities through Google Meet integrated with a Digital Literacy Program. Students received instructional materials, designed digital posters using Canva, and uploaded their work to Padlet for presentation and discussion. These activities encouraged students to access information, create digital content, communicate ideas, and collaborate with their peers throughout the learning process. Meanwhile, the control group participated in online learning through Google Meet using the same instructional materials without the integration of Canva and Padlet. After the treatment, both groups completed the post-test to measure their learning outcomes.

The collected data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to summarize students' learning outcomes by calculating the mean and standard deviation. Before hypothesis testing, the data were examined using the Shapiro–Wilk test to assess the normality of the data distribution and

Levene's test to evaluate the homogeneity of variance. Since the normality assumption was not fully satisfied, non-parametric statistical tests were employed. The Mann–Whitney U test was used to compare the post-test scores between the experimental and control groups, while the Wilcoxon Signed-Rank test was used to compare the pre-test and post-test scores within each group. All statistical analyses were conducted using a significance level of 0.05.

C.Results and Discussion

The descriptive statistics of students' learning outcomes are presented in Table 1. Before the implementation of the Digital Literacy Program, the experimental group obtained a mean pre-test score of 78.93 (SD = 18.17), while the control group obtained a mean pre-test score of 66.40 (SD = 11.98). After the treatment, the mean score of the experimental group increased to 84.53 (SD = 21.85), whereas the control group achieved a mean post-test score of 69.87 (SD = 10.68).

Table 1. Descriptive Statistics of Students' Learning Outcomes

<i>Group</i>	<i>Test</i>	<i>N</i>	<i>Mean</i>	<i>SD</i>
Experimental	Pre-test	15	78,93	18,17
Experimental	Pre-test	15	84,53	21,85

Control	Post-test	15	66,40	11,98
Control	Post-test	15	69,87	10,68

To determine the appropriate statistical analysis, the data were first examined using the Shapiro–Wilk normality test and Levene's test for homogeneity of variance. The normality test indicated that the pre-test and post-test scores of the experimental group were not normally distributed, whereas both datasets in the control group met the normality assumption. The results of the homogeneity test showed that the variances of both groups were homogeneous. Since the assumption of normality was not fully satisfied, non-parametric statistical tests were employed for hypothesis testing.

Table 2. Results of the Normality and Homogeneity Tests

The hypothesis was tested using the Mann–Whitney U test and the Wilcoxon Signed-Rank test. The Mann–Whitney U test was conducted to compare the post-test scores between the experimental and control groups. The analysis yielded a significance value of 0.005, indicating a statistically significant difference

between the post-test scores of the two groups.

The Wilcoxon Signed-Rank test was conducted to compare the pre-test and post-test scores within each group. The significance value for the experimental group was 0.083, while the control group obtained a significance value of 0.286. Both values exceeded the significance level of 0.05, indicating that no statistically significant differences were found between the pre-test and post-test scores within either group.

Table 3. Results of the Hypothesis Testing

<i>Test</i>	<i>Variable</i>	<i>Sig.</i>	<i>Interpretation</i>
Shapiro–Wilk	Experimental Pre-test	0,001	Not Normally Distributed
Shapiro–Wilk	Experimental Pre-test	<0,001	Not Normally Distributed
Shapiro–Wilk	Control Pre-test	0,204	Normally Distributed
Shapiro–Wilk	Control Pre-test	0,897	Normally Distributed
Levene's Test	Pre-test	0,545	Homogeneous
Levene's Test	Post-test	0,517	Homogeneous

<i>Test</i>	<i>Variable</i>	<i>Sig.</i>	<i>Interpretation</i>
Mann–Whitney U Test	Experimental vs. Control (Post-test)	0,005	Significant Difference
Wilcoxon Signed-Rank Test	Experimental (Pre-test vs. Post-test)	0,083	Not Significant
Wilcoxon Signed-Rank Test	Control (Pre-test vs. Post-test)	0,286	Not Significant

Overall, the statistical analyses demonstrated a significant difference between the post-test scores of the experimental and control groups. However, the comparisons of pre-test and post-test scores within the experimental group and the control group did not reveal statistically significant differences.

This study examined the effectiveness of a Digital Literacy Program in bridging the digital divide among tenth-grade students at MAN 1 Kota Pekalongan. The statistical findings revealed a significant difference between the experimental and control groups based on the Mann–Whitney U test. However, the Wilcoxon signed-rank test indicated no statistically significant improvement within either the experimental or the control group. These findings suggest that participation in the Digital Literacy Program was associated with different digital literacy outcomes between the two groups, although the intervention

did not produce statistically significant changes within the experimental group during the implementation period.

The significant difference between groups may indicate that structured digital literacy activities provided students with learning experiences that differed from those of students who received conventional online instruction. The experimental group engaged in activities involving Google Meet, Canva, and Padlet, which required students not only to access digital information but also to create digital content and collaborate in online learning environments. Such activities are consistent with the multidimensional concept of digital literacy proposed in the DigComp framework, which emphasizes competencies related to information management, communication, digital content creation, safety, and problem-solving. These findings support the view that digital literacy programs can facilitate the development of broader digital competencies through authentic learning experiences.

The findings are also consistent with previous studies highlighting the

educational value of structured digital literacy programs. Blažič and Blažič (2020) argue that systematic digital literacy instruction helps learners develop practical digital competencies, while Ng et al. (2023) demonstrate that technology-supported learning activities can strengthen students' digital literacy through active participation. Likewise, García-Peñalvo et al. (2024) emphasize that successful educational innovation depends on meaningful integration of digital technologies into teaching and learning processes rather than simply introducing new technological tools. The implementation of Canva and Padlet in this study reflects this pedagogical approach by encouraging students to interact with digital resources in authentic learning contexts.

Although a significant difference was identified between the experimental and control groups, the absence of statistically significant improvement within the experimental group suggests that the intervention period may not have been sufficient to generate measurable changes in students' digital competencies. Digital

literacy is widely recognized as a complex competence that develops gradually through repeated practice, continuous feedback, and sustained educational support rather than through short-term instructional activities. Therefore, the findings should not be interpreted as evidence that the program substantially improved students' digital literacy during the study period but rather as an indication that structured digital literacy instruction may contribute to differences in learning experiences and outcomes when compared with conventional instruction.

From the perspective of the digital divide, the findings indicate that differences in students' digital competencies cannot be addressed solely by providing access to digital technologies. Van Deursen and van Dijk (2019) explain that contemporary digital inequality increasingly reflects disparities in digital skills and the capacity to use technology effectively rather than differences in physical access. Similarly, van de Werfhorst et al. (2022) argue that educational inequalities related to digital readiness require systematic instructional support within schools. In this study,

the Digital Literacy Program provided structured opportunities for students to engage with digital technologies in meaningful ways, suggesting that school-based interventions can contribute to addressing aspects of the digital divide, even though measurable improvements within the experimental group were not statistically significant.

Several limitations should be considered when interpreting these findings. The study involved a relatively small sample of students from a single madrasah, which may limit the generalizability of the results. In addition, the duration of the intervention was relatively short, potentially limiting observable changes in students' digital competencies. Future research is therefore recommended to involve larger participant groups, longer intervention periods, and multiple educational settings to provide more comprehensive evidence regarding the effectiveness of digital literacy programs in bridging the digital divide.

E. Conclusion

This study investigated the effectiveness of a Digital Literacy Program in bridging the digital divide

among tenth-grade students at MAN 1 Kota Pekalongan using a quasi-experimental design. The findings revealed a statistically significant difference between the experimental and control groups, indicating that the implementation of the Digital Literacy Program was associated with different digital literacy outcomes compared with conventional online instruction. However, no statistically significant improvement was found within either the experimental or the control group during the intervention period.

These findings suggest that structured digital literacy activities have the potential to support efforts to address the digital divide by providing students with meaningful opportunities to develop and apply digital competencies in educational settings. Nevertheless, the results also indicate that a short-term intervention alone may not be sufficient to produce statistically significant improvements in students' digital competencies. Therefore, the effectiveness of digital literacy programs should be viewed as a gradual process that requires sustained implementation, appropriate pedagogical support, and continuous engagement.

Future research is recommended to involve larger samples, longer intervention periods, and diverse educational contexts to provide stronger empirical evidence regarding the role of digital literacy programs in bridging the digital divide among secondary school students.

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