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The Effectiveness of the Unplugged Informatics Approach in Improving Junior High School Students' Digital Literacy and Ethics

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Abstract

Even though the Merdeka Curriculum mandates the Social Impact of Informatics (DSI) as a vital component, many middle school students face persistent challenges in detecting online falsehoods and maintaining ethical behavior online. This investigation aimed to analyze the impact of the Informatics Unplugged strategy on enhancing digital literacy and ethical awareness among students. A quantitative quasi-experimental approach featuring a Non-equivalent Control Group Design was deployed. The participant pool comprised eighth-grade students at SMP Negeri 2 Tulangan; samples were gathered through purposive sampling, allocating one group to an experimental class utilizing Informatics Unplugged and another to a control class under conventional teaching. Data collection instruments included a validated digital literacy test and a digital ethics questionnaire. For data analysis, paired-sample t-tests, independent-sample t-tests, and normalized gain (N-Gain) metrics were applied. The empirical evidence demonstrated a statistically significant divergence between the experimental and control cohorts ($p < .05$). The experimental set recorded a high N-Gain of 0.74, contrasting with the control set's 0.38, which marks a superior progress in both digital literacy and ethics. Ultimately, the study confirms that the Informatics Unplugged model is highly capable of driving improvements in students' digital competence, making it an advantageous instructional alternative for teaching DSI contextually.

Keywords: Digital ethics; Digital literacy; Informatics unplugged; Learning outcomes; Junior high school.

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INTRODUCTION

The implementation of the Independent Curriculum in Informatics subjects places the Social Impact of Informatics (DSI) material as a crucial pillar in shaping the character of the younger generation in the digital space. At the junior high school (SMP) level, this material ideally serves as a foundation for students to develop healthy and responsible digital citizenship (Ribble, 2015). However, the reality on the ground shows a significant gap between theoretical knowledge and students' daily digital behavior. Massive gadget access among adolescents does not necessarily correlate positively with their level of digital maturity. The Digital Civility Index (DCI) report by Microsoft (2021) and the latest data from the Indonesian Internet Service Providers Association (APJII, 2024) confirm that adolescent internet users in Indonesia remain vulnerable to digital risks. The

phenomenon of high rates of cyberbullying, low ability to filter information that triggers the spread of fake news (hoaxes), and minimal ethics in communicating on social media are clear evidence that the digital space of eighth grade students is still in a morality and literacy crisis (Rezayi, Balakrishnan, Arabnia & Arabnia, 2018) (Pratama & Suwarti, 2023).

This situation is exacerbated by the conventional, teacher-centered approach to DSI learning in schools. DSI learning often falls into monotonous lectures or simply requires students to read text from digital textbooks independently (Sanjaya, 2021; Thompson & Harris, 2025). When learning is shifted to computer labs or personal devices under the guise of technology integration, students are often distracted by social media notifications or online games, preventing the essence of the material from being conveyed optimally (Sebire, Gregory, Bannister-Tyrrell, & Nye, 2020; Wang, Chen, Yu, & Jing, 2024). As a result, students' understanding of digital literacy and ethics concepts remains limited to low-level memorization (LOTS) cognitive skills, failing to foster digital empathy or critical thinking skills to verify the accuracy of information before sharing it with others (Kurnia & Astuti, 2022; Neugnot-Cerioli & Laurenty, 2024).

Nevertheless, a review of prior literature indicates that the majority of studies on *Informatics Unplugged* remain dominated by topics centered on cognitive development, including computational thinking, algorithms, and programming (Caeli & Yadav, 2020; Huang & Looi, 2021). Explorations regarding the reliability of this method in stimulating digital literacy and digital ethics—particularly within the topic of the Social Impacts of Informatics at the junior high school level—remain highly scarce (Ilomäki, Lakkala, Kallunki, Mundy, & Romero, 2023). Furthermore, few previous studies have integrated hoax dissemination simulations or cyberbullying role-playing as instructional tools to foster digital citizenship character (Liu & Shadiev, 2025; Waldi, Wardi, Lubis, & Habibah, 2026). This scientific gap underscores the pressing urgency for a new empirical study that does not merely focus on the cognitive domain, but also measures the progress of students' digital literacy and digital ethics competencies in the modern era.

Addressing this research void, the novelty introduced in this study rests upon three crucial points. First, the implementation of the *Informatics Unplugged* method is specifically focused on the Social Impacts of Informatics subject matter under the *Kurikulum Merdeka* (Independent Curriculum). Second, this study evaluates the learning impact on two competencies simultaneously, namely digital ethics and digital literacy. Third, the learning process is formulated through simulations of fake news dissemination and cyberbullying role-playing to provide a contextual learning experience for strengthening students' digital citizenship character. On that basis, this research is projected to test the effectiveness of *Informatics Unplugged* in driving the improvement of junior high school students' digital literacy and ethics, while simultaneously presenting empirical data regarding the application of experiential learning to the Social Impacts of Informatics material.

RESEARCH METHOD

This research utilized a quantitative, quasi-experimental framework via a non-equivalent control group design. Randomization was bypassed because the subjects belonged to naturally formed classes at SMP Negeri 2 Tulangan, and maintaining a

stable learning environment was a priority. The treatment's effectiveness was analyzed by comparing the pre-test and post-test results of both the control and experimental groups, with the layout detailed in Table 1.

Table 1. Research Design: Pretest–Posttest Control Group Design

Group	Pre-test	Treatment	Post-test
Experiment (E)	O1	X	O2
Control (K)	O3	—	O4

Information:

E	:	Experimental Group (Learning with the Unplugged Informatics approach)
K	:	Control Group (Learning with a conventional approach)
O1, O3	:	Initial measurement (Pre-test) of students' digital literacy and ethics
O2, O4	:	Final measurement (Post-test) of students' digital literacy and ethics
X	:	Treatment in the form of implementing the Unplugged Informatics learning approach

This research focused on the entire eighth-grade student body at SMP Negeri 2 Tulangan registered for the ongoing school year. To select the participants, a purposive sampling approach was employed, based on the uniformity of their prior semester's informatics grades and suggestions from the school's mentor teachers. Based on this technique, two classes were selected as research samples. Class VIII-A was designated as the experimental class receiving learning with the Unplugged Informatics approach, while class VIII-B was designated as the control class receiving conventional learning. Each class had subject characteristics equivalent to a total of 32 students, resulting in a total sample of 64 students.

Research data was collected using two main types of instruments that had been declared valid and reliable through instrument testing before the research was conducted: Digital Literacy Cognitive Test is the instrument consists of 20 two-tier multiple-choice questions. It is designed to measure students' information literacy, specifically their ability to analyze the veracity of digital information, identify the characteristics of fake news (hoaxes), and understand digital legal regulations (the Electronic Information and Transactions Law). Digital Ethics Attitude Scale Questionnaire is the questionnaire is a Likert-scale questionnaire (1–5) designed to measure students' affective domains and behavioral tendencies. Indicators assessed include awareness of wise social media use, digital empathy to reduce cyberbullying, and the application of the principle of filtering before sharing.

All quantitative data obtained was processed using SPSS statistical software. The data analysis steps were as follows:Prerequisite Analysis Test is conducting a normality test using the Shapiro-Wilk method (considering the number of samples per class < 50 students) and a homogeneity of variance test using Levene's Test on pre-test and post-test scores. Hypothesis Test (Effectiveness Test) if the data is normally distributed and homogeneous, the analysis continues with a paired sample t-test to determine the significance of internal improvements in each class. Next, an independent sample t-test is performed to compare the effectiveness of improvements between the experimental and control classes. If the data does not

meet the assumption of normality, non-parametric statistics such as the Wilcoxon Signed-Rank Test and the Mann-Whitney U Test will be used as alternatives. And N-Gain Value Analysis to determine the effectiveness of improving the quality of digital literacy and ethics quantitatively, a normalized Gain score (N-gain) was calculated based on the Hake formula with the criteria for obtaining the N-gain value are then categorized into three levels, namely high ($g > 0.7$), medium ($0.3 \leq g \leq 0.7$), and low ($g < 0.3$).

RESULTS AND DISCUSSION

Result

To analyze the efficacy of Informatics Unplugged in developing junior high students' digital literacy and ethics, an analysis was performed on 64 students split equally between an experimental class (VIII-A) and a control class (VIII-B). The data analysis routine incorporated descriptive statistics, prerequisite checks, hypothesis tests, and effect size measures. Both groups exhibited higher scores post-intervention, though the experimental class achieved superior growth. The mean score for the experimental group progressed from 51.88 (pre-test) to 85.78 (post-test), whereas the control group shifted from 52.50 to 69.84. Additionally, the experimental class attained a high-tier mean N-Gain of 0.7063, contrasting with the control class's medium-tier N-Gain of 0.3663.

Table 2. Descriptive Statistics of Learning Outcomes

Group	Pre-test	Post-test	N-Gain	Category
Experimental	51,88	85,78	0,7063	High
Control	52,50	69,84	0,3663	Medium

According to Table 2, both student cohorts started with highly similar prior knowledge, evidenced by pre-test averages of 51.88 for the experimental class and 52.50 for the control class. Post-intervention, the experimental group's mean score climbed to 85.78, while the control group reached 69.84. The resulting N-Gain for the experimental class was 0.7063 (high category), outperforming the control class's score of 0.3663 (medium category). These outcomes verify that the experimental teaching method generated a higher margin of student improvement than the conventional format.

Assumption Tests

Test of Normality

Data distribution was examined using the Shapiro-Wilk method for normality testing, with the comprehensive results summarized in Table 3.

Table 3. Statistical Distribution and Normality Results

Variable	Group	Sig.	Description
Pre-test	Experimental	0,0376	Non normal
Pre-test	Control	0,0005	Non normal
Post-test	Experimental	0,0001	Non normal
Post-test	Control	0,0291	Non normal
N-Gain	Experimental	0,1124	Normal
N-Gain	Control	0,0194	Non normal

Normality testing indicated that most data were non-normally distributed, with significance values remaining lower than 0.05. The only data set that conformed to a normal distribution was the experimental class's N-Gain, which registered a significance value of 0.1124.

Homogeneity Test

Group variance equality was examined via Levene's Test for homogeneity, with the comprehensive results summarized in Table 4.

Table 4. Variance Homogeneity Results

Variable	Levene Statistic	Sig.	Description
Pre-test	0,0000	1,0000	Homogen
Post-test	5,1755	0,0264	Non Homogen
N-Gain	17,6695	0,0001	Non Homogen

According to Table 4, the baseline pre-test data demonstrated variance homogeneity. Conversely, the post-test and N-Gain data exhibited non-homogeneous variances, given that their p-values fell below the 0.05 threshold.

Hypothesis Testing

Within-Group Improvement Test

A paired sample t-test was used to determine the improvement in learning outcomes within each group.

Table 5. Paired Sample t-Test Results

Group	Mean Pre-test	Mean Post-test	t	Sig.
Exsperimental	51,88	85,78	39,3446	<0,001
Control	52,50	69,84	17,2810	<0,001

The analysis reveals that both the experimental and control groups achieved significant improvements following the intervention. The p-values for both groups were below 0.05, indicating a statistically significant difference between pre-test and post-test scores.

Inter-Group Difference Analysis

The relative effectiveness of Informatics Unplugged versus standard instruction was examined by applying an independent samples t-test to the N-Gain metrics, with the comprehensive results summarized in Table 6.

Table 6. Independent t-Test Data

Variable	t	df	Sig.
N-Gain	14,5077	62	<0,001

The test results reveal a significance value below 0.05; hence, the research hypothesis is accepted. Consequently, a statistically significant difference exists in the enhancement of digital literacy and digital ethics between students instructed through the Informatics Unplugged approach and those taught via conventional methods.

Effect Size Measurement

To evaluate the magnitude of the intervention's effect, effect size analysis was performed employing Cohen's d.

Table 7. Results of Effect Size Analysis

Variabel	Cohen's d	Interpretation
N-Gain	3,6269	very large effect

A Cohen's d value of 3.6269 indicates that the Informatics Unplugged approach has a very large effect on improving students' digital literacy and digital ethics. This value far exceeds the threshold for the large effect category ($d > 0.80$), thereby practically proving that this approach is effective for use in Informatics learning, specifically on the Social Impacts of Informatics topic.

Discussion

Based on the data, the Informatics Unplugged approach proved significantly more effective at upgrading digital literacy and ethics among students compared to standard methods. The experimental class secured a high-category mean N-Gain of 0.7063, whereas the control class only reached a medium-category N-Gain of 0.3663. Furthermore, results from the independent samples t-test verify that this difference in student improvement is statistically significant ($p < .001$). This phenomenon implies that instructional processes providing opportunities for direct student engagement can foster a deeper mastery of the social impacts of informatics, contrasting sharply with traditional teacher-centered lectures (Zhang, Yu, Xia, Yang, & ja, 2026).

The acceleration of digital literacy skills in the experimental group was driven by the core characteristics of Informatics Unplugged, which integrates physical activities, simulations, and teamwork. By visualizing information flow through simple props, students directly observed how hoaxes proliferate instead of merely memorizing theoretical definitions (Sokolova, Antonian, & Pylkin, 2025). This finding aligns with argued that unplugged methods facilitate students in internalizing complex informatics concepts through meaningful and contextual learning experiences (Tusher, Ismail, Rahman, Alenezi, & Uddin, 2024). This model enables learners to construct knowledge from concrete realities, thereby rendering the transfer of knowledge more efficient and applicable.

In the domain of digital ethics, the marked increase in the experimental class indicates that experiential learning plays a crucial role in shaping students' social awareness within digital spaces. Through role-playing scenarios and simulations of cyberbullying cases, students were encouraged to analyze the consequences of every digital action from multiple perspectives (Gu, Li, Yi, Yang, Liu, & Wang, 2022; Yang & Lu, 2024). This outcome is reinforced by the arguments who stated that digital citizenship education grounded in social reflection and active communication can cultivate empathy and responsibility in technology utilization (Cucasi, Cerrillo, & Cinque, 2025). Consequently, this approach not only targets cognitive dimensions but also guides the formation of positive digital character and behavior.

Theoretically, the success of this approach is consistent with constructivist principles, which posit that knowledge is formed through active interaction between

students and their learning environment (Saleem, Kausar, & Deeba, 2021; Zajda, 2021). Within the framework of Informatics Unplugged, students are positioned as primary subjects who experience, analyze, and discuss simulated digital phenomena in the classroom (Peel, Sadler, & Friedrichsen, 2022). Such a learning climate triggers a stronger cognitive construction than unidirectional, teacher-dominated information transfer. Drawing upon Piaget's theory, interaction with concrete objects serves as a vital foundation that helps learners digest abstract ideas before transitioning to more intricate formal operational reasoning.

In addition, the insights from this study support various global studies indicating that unplugged techniques are not only reliable for honing computational thinking skills but also possess potential application in social dimensions and digital moral development. That computerless informatics education can boost student participation while consolidating conceptual understanding through group work (Lavado-Anguera, Velasco-Quintana, & Terrón-López, 2024; Katalinic, Slavuj, & Jaksic, 2026). Within the context of this research, a similar strategy proved effective in advancing digital literacy and morality, thereby expanding the scope of Informatics Unplugged, which has hitherto been largely confined to algorithms and programming topics.

The magnitude of the impact exerted by Informatics Unplugged is further validated by the effect size analysis using Cohen's *d*, which yielded a value of 3.6269 (classified as a very large effect). This numerical indicator underscores that the pedagogical treatment administered is not merely statistically significant, but also exerts a powerful practical impact on student competence. Therefore, the Informatics Unplugged approach is highly recommended as an alternative instructional strategy for delivering the Social Impacts of Informatics topic at the junior high school level (Kosta & Anže, 2026). This method is proven capable of fostering a dynamic, contextual, and solution-oriented learning experience to address the digital literacy and ethical challenges faced by the younger generation amid the current era of digital transformation.

CONCLUSION

This study confirms that the implementation of the Informatics Unplugged model successfully enhances the digital literacy and digital ethics achievements of eighth-grade junior high school students, particularly within the topic of the Social Impacts of Informatics. The acceleration of competence in the experimental group significantly surpasses that of the control group, as evidenced by the Normalized Gain (N-Gain) score in the high qualification and statistical test results indicating a distinct gap. These empirical findings indicate that the integration of motor activities, reality simulations, group dialogues, and role-playing methods can facilitate students in comprehensively mastering the essence of digital literacy, while simultaneously adopting the principles of digital morality in their daily social interactions.

From a pedagogical perspective, the Informatics Unplugged technique is deemed successful in transforming abstract narratives regarding digital footprints, the dissemination of hoaxes, and cyberbullying into visible, relevant, and highly valuable learning experiences for students. The active participation established in the classroom stimulates students' critical thinking sharpness in verifying

information validity. Furthermore, these activities trigger the emergence of personal awareness to behave in a more courteous, wise, and accountable manner when engaging in virtual spaces.

Theoretically and practically, this study contributes new empirical evidence to the innovation of Informatics instructional methodologies, especially in the domain of the Social Impacts of Informatics, which is frequently delivered merely through theoretical expositions. The novelty of this research expands the functionality of Informatics Unplugged; this method is proven to be not only adaptive for maturing computational reasoning, but also highly effective in strengthening digital literacy understanding and the foundation of students' digital citizenship character.

Nevertheless, the generalization of these research findings is still constrained by the small sample size and a homogeneous school locus. Drawing upon these limitations, future research agendas are recommended to expand the scope of research subjects, test the approach across varied school levels, and implement longitudinal digital behavior evaluation instruments. Such steps are crucial to monitor the extent to which the effectiveness of Informatics Unplugged can foster a healthy digital ecosystem and culture more comprehensively.

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