



The Effectiveness of E-Comic as Learning Materials for Students' Tolerance Attitude Improvement

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Abstract: Background: Conventional teaching materials are considered less effective in increasing tolerance attitudes. Meanwhile, tolerant attitudes are very important for high school students. **Objective:** This study aims to develop e-comics as learning materials to enhance students' tolerance. **Method:** The e-comics were evaluated by material and media experts prior to their use in the classroom. This study employed a questionnaire administered to students both before and after the implementation of the e-comics. The data collected from the questionnaires were analyzed using a t-test to determine the effectiveness of the e-comics in enhancing tolerance attitudes. **Result:** The e-comics were categorized as very good based on assessments by material and media experts, with scores of 84.27% and 94.79%, respectively. The integration of e-comics into the learning process led to a notable improvement in the experimental class's average score, rising from 88.40 to 91.46. This improvement was further supported by t-test results, which confirmed significant differences between the pre-test and post-test scores within the experimental group, as well as between the post-test scores of the experimental and control groups. In contrast, the control group showed no meaningful change between its pre-test and post-test scores. **Conclusion:** E-comics have been shown to enhance students' tolerance attitudes. **Recommendation:** The findings suggest that e-comics are effective in improving students' tolerance attitudes. Therefore, it is recommended that teachers utilize e-comics as an alternative learning medium in Civic Education to promote character development and student engagement.

Keywords: E-Comic, Effectiveness, Learning Materials, Tolerance Attitudes.

فعالية الكوميكس الإلكتروني كوسيلة تعليمية في تحسين مواقف التسامح لدى الطلاب

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الملخص: تعتبر المواد التعليمية التقليدية غير فعالة في تعزيز التسامح، بينما يعد التسامح أمراً مهماً جداً لطلاب المرحلة الثانوية. يهدف هذا البحث إلى تطوير كتاب إلكتروني مصور (كوميكس إلكتروني) كوسيلة تعليمية لتعزيز التسامح بين الطلاب. **الطريقة:** تم تقييم الكتاب الإلكتروني من قبل خبراء المحتوى والوسائط قبل استخدامه في الفصل. استخدمت استبيانات لقياس مستوى التسامح لدى الطلاب قبل وبعد تطبيق الكتاب الإلكتروني، وتم تحليل البيانات باستخدام اختبار T لقياس فعالية الكتاب الإلكتروني في تعزيز التسامح. **النتائج:** تم تصنيف الكتاب الإلكتروني على أنه "جيد جداً" وفقاً لتقييم الخبراء، حيث حصل على درجات 84.27% و 94.79% كما أدى استخدام الكتاب الإلكتروني إلى زيادة متوسط درجات طلاب المجموعة التجريبية من 88.40 إلى 91.46. أظهر اختبار T وجود فرق واضح بين متوسط درجات الطلاب قبل وبعد التطبيق، مما يثبت فعالية الكتاب الإلكتروني في تحسين مستوى التسامح. **الاستنتاج:** أثبت الكتاب الإلكتروني فعاليته في تعزيز التسامح لدى الطلاب. **التوصية:** تشير نتائج الدراسة إلى أن القصص المصورة الإلكترونية فعالة في تحسين مواقف التسامح لدى الطلاب. ولذلك يُوصى بأن يستخدم المعلمون القصص المصورة الإلكترونية كوسيلة تعليمية بديلة في مادة التربية المدنية لتعزيز تنمية الشخصية وزيادة تفاعل الطلاب في عملية التعلم.

الكلمات المفتاحية: كتاب إلكتروني مصور، الفعالية، المواد التعليمية، التسامح.

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Introduction

Adolescence represents a critical stage of life that bridges childhood and adulthood, characterized by profound changes in a young person's body, emotions, social relationships, and thinking abilities (Suryana *et al.*, 2022). During this stage, adolescents often feel a strong urge to express their identity. However, this search for self-expression can sometimes lead to acts of juvenile delinquency, which may, in turn, foster attitudes of intolerance. Cases of intolerance that frequently occur among teenagers are brawls (Nurhadiyanto *et al.*, 2024) and bullying (Rahmawati *et al.*, 2022). Preventive measures need to be implemented to address juvenile delinquency.

One of the steps to prevent juvenile delinquency is through character education (Rofi'ie, 2017). One key factor in the success of character education lies in selecting learning materials that are both relevant and effective (Setya *et al.*, 2024). Civic Education teaches character education that builds thinking, character, and attitudes (Ginting & Brutu, 2023). Unfortunately, the Civic Education learning process is often less effective (Tapa & Hidayah, 2023). Studies have shown that Civic Education is often perceived as dull and unengaging, largely because it relies heavily on rote memorization rather than interactive or meaningful learning experiences (Rizki *et al.*, 2023; Rora *et al.*, 2022). Student interest is key to successful learning (Ernawati *et al.*, 2022). One effective way to boost student engagement is by shifting the focus away from rote memorization and placing greater emphasis on practical, real-world applications of the material (Rizki *et al.*, 2023; Serunai *et al.*, 2022).

A key objective of Civic Education is to foster a spirit of tolerance. Cultivating this attitude is vital, as it encourages empathy, strengthens social bonds, and helps prevent the

emergence of conflict within communities (Hsu, 2024; Tarumingi *et al.*, 2024). Fostering tolerance among high school students is especially important, as it helps build a positive and inclusive atmosphere. It nurtures a generation that values diversity, respects different backgrounds, and forms stronger, more respectful relationships with their peers (Ghanimah, 2024; Siswoko *et al.*, 2023). Promoting a stronger attitude of tolerance among students is essential. One effective way to support this is by integrating tolerance into the educational curriculum. This can be done through the use of engaging and thoughtfully chosen learning materials. When materials are relevant and well-designed, they play a crucial role in deepening students' understanding and encouraging more inclusive attitudes (Ahmed, 2024).

Developing an e-comic can increase students' interest in learning (Surya *et al.*, 2020). E-comics contain a rich and varied vocabulary that tends to be retained by readers who engage with them consistently over the course of a month (Bukian *et al.*, 2024). High school students aged around 15-19 years. This age is entering adolescence (Sawyer *et al.*, 2018). Previous research has shown that adolescents are highly interested in e-comics (Arisani *et al.*, 2019; Dallacqua *et al.*, 2022; Septialti *et al.*, 2022). E-comics are considered to have visuals and stories that are easy to understand (Golding & Verrier, 2021). Using comics in learning is expected to keep students engaged and prevent boredom, while also helping them grasp the concept of motion more easily. E-comics, with their vibrant images and colors, stimulate brain activity by quickly forming neural connections. As a result, students are encouraged to think in more concrete and critical ways (Nurvika & Susarno, 2018). Comics have proven effective in broadening students' appreciation and acceptance of different types of literature.

Research conducted by Anggito and Sartono (2022) showed that the development of multicultural-based educational comics significantly improved students' average field test scores (Anggito & Sartono, 2022). The increase in the average class score also occurred when learning about disaster mitigation using e-comics. This increase in the average class score is attributed to students' interest in learning and their improved understanding (Indriana *et al.*, 2024). The use of e-comics in physics learning, with a focus on global warming, demonstrates students' interest in the teaching material (Serevina *et al.*, 2021). Using e-comics in mathematics learning can improve students' critical thinking skills and creativity. (Yulaichah *et al.*, 2024). The use of e-comics consistently has a positive impact on increasing students' interest in learning. Research showed that students' interest in learning is the main factor in achieving learning objectives (Jumasih, 2023; Wahdi *et al.*, 2024). As of now, there has been no implementation of e-comics in civic education to foster tolerant attitudes. Learning with story-based and visual teaching materials was effective in achieving learning objectives that focused on improving attitudes (Khoesnan, 2018; Misdalipah & Fauzan, 2023).

Although there is increasing interest in utilizing e-comics as educational tools, a notable research gap exists in their impact on affective learning outcomes, specifically in fostering tolerance attitudes. Most existing studies have primarily focused on the cognitive benefits of e-comics in subjects such as science, mathematics, and disaster education (Indriana *et al.*, 2024; Serevina *et al.*, 2021; Yulaichah *et al.*, 2024). These studies demonstrate increased comprehension and student engagement, but do not explicitly address how e-comics influence values or character education.

Furthermore, while some research has indicated that story-based media can influence

students' emotional responses (Mahartini & Tristananda, 2025), few have employed rigorous statistical methods—such as T-tests—to validate the effectiveness of e-comics in promoting tolerance. This study fills that gap by using inferential statistics to demonstrate significant changes in students' tolerance levels (Hanusz *et al.*, 2016).

Another important gap is the underutilization of e-comics in Civic Education. While e-comics are commonly applied in subjects like science and language, their potential to enhance moral and civic learning remains largely unexplored (Ginting & Brutu, 2023; Khoesnan, 2018). Considering the crucial role Civic Education plays in fostering democratic and inclusive values, the absence of visually engaging, narrative-driven learning tools represents a significant missed opportunity to enhance student understanding and engagement.

This study was guided by a series of key questions focused on understanding how e-comics might enhance students' attitudes toward tolerance. The primary question asked: How effective are e-comics as educational tools in fostering tolerance among high school students? To answer this, the research examined changes in students' tolerance levels before and after the integration of e-comics into Civic Education lessons. It also explored which specific aspects of tolerance—such as embracing diversity, practicing forgiveness, and critically recognizing intolerance—were most impacted by the intervention. In addition, the study looked into students' perceptions of e-comics as a medium for encouraging empathy, inclusivity, and mutual respect, ultimately supporting character formation within the framework of Civic Education.

This study holds substantial value in both theoretical and practical aspects. From a theoretical perspective, it adds to the expanding

literature on utilizing digital learning media, specifically e-comics, in affective education. While previous research has predominantly focused on the cognitive outcomes of e-comic use, this study emphasizes their potential to foster character development among high school students. By integrating statistical validation via T-tests, this study offers strong empirical evidence backing the affective influence of e-comics, addressing a gap in current educational media research.

Practically, the study provides valuable insights for educators, curriculum developers, and policymakers. For educators, it introduces e-comics as a creative and captivating substitute for conventional teaching materials in Civic Education, which are frequently seen as dull and less efficient in instilling moral values. Utilizing e-comics can boost student motivation, empathy, and comprehension of diversity in the classroom. For policymakers and curriculum designers, the findings emphasize the significance of incorporating visual and narrative-based learning tools into national character education initiatives. Considering the widespread access to digital technology among students, e-comics also offer a cost-effective and scalable solution for promoting tolerance and inclusive values in diverse educational settings.

Researchers have created e-comics as instructional materials for civic education. Experts in materials and media evaluated the appropriateness of e-comics as teaching materials. The e-comics narrated the tale of three friends who venture into a peculiar world following a massive earthquake. The narrative in the e-comic depicted the significance of maintaining a tolerant attitude in daily life. E-comics were utilized in classroom instruction employing the Problem-Based Learning model. The application of this model can encourage cooperation and student engagement while also fostering student self-confidence when

working in groups (Sompal et al., 2021). The development of e-comic teaching materials is essential to complement traditional resources, which often fall short in fostering attitudes of tolerance. Conventional materials like textbooks tend to be monotonous, lack innovation, and have limited impact on engaging students or encouraging inclusive thinking within Civic Education (Wang, 2022).

Methods

Research design

E-comics formation: The e-comic was structured with numerous essential elements, starting with the cover and an introduction segment that encompassed the main title, foreword, invitation to prayer, learning objectives, user instructions, and a table of contents. The central section delineated the primary narrative of the e-comic, whilst the concluding segment included an assessment sheet, scoring criteria, answer analyses, a learning reflection, and a succinct profile of the developer. The narrative illustrated the obstacles encountered by three companions, each with unique personalities and traits. After a large earthquake, the three friends discovered themselves in an unusual realm. The generated e-comics were incorporated in Appendix C.

Assessment of e-comics by media and material experts: Experts in media and materials carried out the evaluation of the e-comics. The assessment aims to determine feasibility based on various parameters. Media parameters encompass material, illustration, media quality, appearance, and appeal. Conversely, material parameters comprise format, language, illustration, and content. Each parameter consists of several statements that will be assessed on a scale of 1-4, as shown in Table 1. The assessment results were processed into a percentage scale score using Equation 1. This score was used to categorize the quality of the e-comics based on the table.

Table (1): Media and materials expert assessment scale.

Category	Score
Very appropriate	4
Appropriate	3
Less appropriate	2
Inappropriate	1

$$\%S = \frac{x}{y} \times 100\% \dots \dots \dots (1)$$

$\%S$ = score percentage
 x = total score
 y = maximum score

Table (2): E-comic assessment categories.

Score Percentage	Categories
0%-20%	Unsatisfactory
20.1%-60%	less good
60.1%-80%	good
80.1%-100%	excellent

E-comics effectiveness test: Control and experimental groups were employed to evaluate the efficacy of e-comics. In the experimental class, instruction utilized conventional teaching materials, including PowerPoint presentations and textbooks, supplemented by e-comics as additional resources. In contrast, the control group employed exclusively conventional instructional resources for education.

Students in both the control and experimental groups completed pre-test and post-test questionnaires. The pre-test questionnaire evaluated the tolerance attitudes of both classes before civic education training commenced. The post-test questionnaire subsequently assessed tolerance attitudes after civic education instruction. The data obtained from the pre-test and post-test questionnaires for both the control and experimental groups were transformed into percentage scores for each student utilizing Equation (1). To validate the results, all data were initially analyzed by required statistical tests, including evaluations of homogeneity and normality, utilizing Minitab 18. The efficacy of e-comics in promoting students' tolerance attitudes was then assessed using a t-test analysis. This

analysis examined the mean scores of the experimental group prior to and following the intervention, the post-test outcomes of both the experimental and control groups, and the pre- and post-test scores of the control group.

1. Participan

The study took place at Senior High School 1 Karanganyar, involving tenth-grade participants. Students were divided into two classes: a control class and an experimental class, each with 36 students. The selection of these classes was based on the findings of a preliminary research study by the researcher, indicating a similarity in tolerance attitudes.

2. Operational Definitions of Key Terms

In this study, several key terms are defined operationally to avoid ambiguity. Tolerance refers to the respect, acceptance, and appreciation of diversity in culture, religion, and opinion (Maromi *et al.*, 2024). Tolerance attitudes are defined as students' predispositions to demonstrate tolerance, which were measured through a questionnaire consisting of indicators such as appreciation for diversity, willingness to forgive, avoiding prejudice, and recognizing the causes of intolerance. E-comics are defined as digital comics used as instructional materials, developed and validated by media and material experts, and applied in Civic Education classes to foster tolerance attitudes (Anggito & Sartono, 2022).

3. Research Instrumen

This study employed a quantitative approach to assess changes in students' tolerance attitudes before and after Civic Education instruction. To measure these attitudes, the researchers developed a questionnaire grounded in ten key indicators of tolerance (see Appendix B). The questionnaire was administered in two phases: the pre-test consisted of 20 multiple-choice questions, while the post-test included 10 multiple-choice

items and five essay questions (Appendix B).

The pre-test and post-test questionnaires were evaluated for both validity and reliability using Minitab 18. The validity test aimed to ensure that each question accurately measured the intended aspect of students' tolerance attitudes (Sugiarta *et al.*, 2023). The value of all Rcount in Table 3 was higher than the Rtable. Therefore, all pre-test and post-test

Table (3): The result of the validity test.

Question	R table (N= 72)	Type of Questions	Pre-Test		Type of Questions	Post-Test	
			R count	Information		R count	Information
1			0.2960	Valid		0.4680	Valid
2			0.5200	Valid		0.5440	Valid
3			0.5840	Valid		0.5710	Valid
4			0.4000	Valid		0.6410	Valid
5			0.5290	Valid	Multiple choice	0.6440	Valid
6			0.3380	Valid		0.5990	Valid
7			0.5500	Valid		0.6510	Valid
8			0.5110	Valid		0.7560	Valid
9			0.5720	Valid		0.6660	Valid
10	0.2319	Multiple choice	0.4930	Valid		0.6040	Valid
11			0.4850	Valid		0.6570	Valid
12			0.4930	Valid		0.6000	Valid
13			0.4910	Valid	Essay	0.2400	Valid
14			0.5450	Valid		0.6330	Valid
15			0.4430	Valid		0.4720	Valid
16			0.5570	Valid			
17			0.5570	Valid			
18			0.3530	Valid			
19			0.5220	Valid			
20			0.5410	Valid			

Table (4): The result of the reliability test.

R table (N=72)	Type of Questions	Cronbach's Alpha Pre-test Questionnaire	Type of Questions	Cronbach's Alpha Post-test Questionnaire
0.2319	Multiple choice	0.8270	Multiple choice	0.8059
			Essay	0.3553

Results and Discussion

1. The eligibility of e-comics as learning material

The suitability of the e-comics as instructional material was evaluated by both content and media experts. Their assessments, summarized in Table 5, indicated high-quality results. According to the material expert, the format, language, and illustration components were rated as “very good,” while the content component received a “good” rating. Meanwhile, all media-related indicators were consistently rated in the “very good” category.

questionnaire questions were valid and suitable for this study.

A reliability test was conducted to assess the repeatability of a questionnaire (Mohajan, 2017). This reliability test supported the validity of the findings (Maulana, 2022). Cronbach's Alpha was higher than the Rtable (Table 4). These results indicated that the questionnaires were reliable and suitable for this research.

Overall, the average scores across both evaluations confirmed that the e-comics met the required standards for both content and media quality.

Table (5): The results of material and media expert assessment.

Assessment			
Material Expert Indicators	Score (%)	Media Expert	Score (%)
		Indicators	
Format	100.00	Material	91.67
Language	85.00	Illustration	100.00
Illustration	81.25	Media Quality and Appearance	87.50
Content	70.83	Attractiveness	100.00
Average	84.27	Average	94.79

2. Data Pre-Requisite Test

Normality Test of Questionnaire: A normality test was conducted to prove whether the questionnaire's data was normally distributed (Razali *et al.*, 2012). Normality testing used the *Shapiro-Wilk* method because the sample size was small (less than 50) (Razali

et al., 2012). As shown in Figure 1, the data points closely followed a straight line, and the P-value exceeded 0.1—well above the significance threshold of $\alpha = 0.05$. These results indicate that the questionnaire data for both the control and experimental groups were normally distributed.

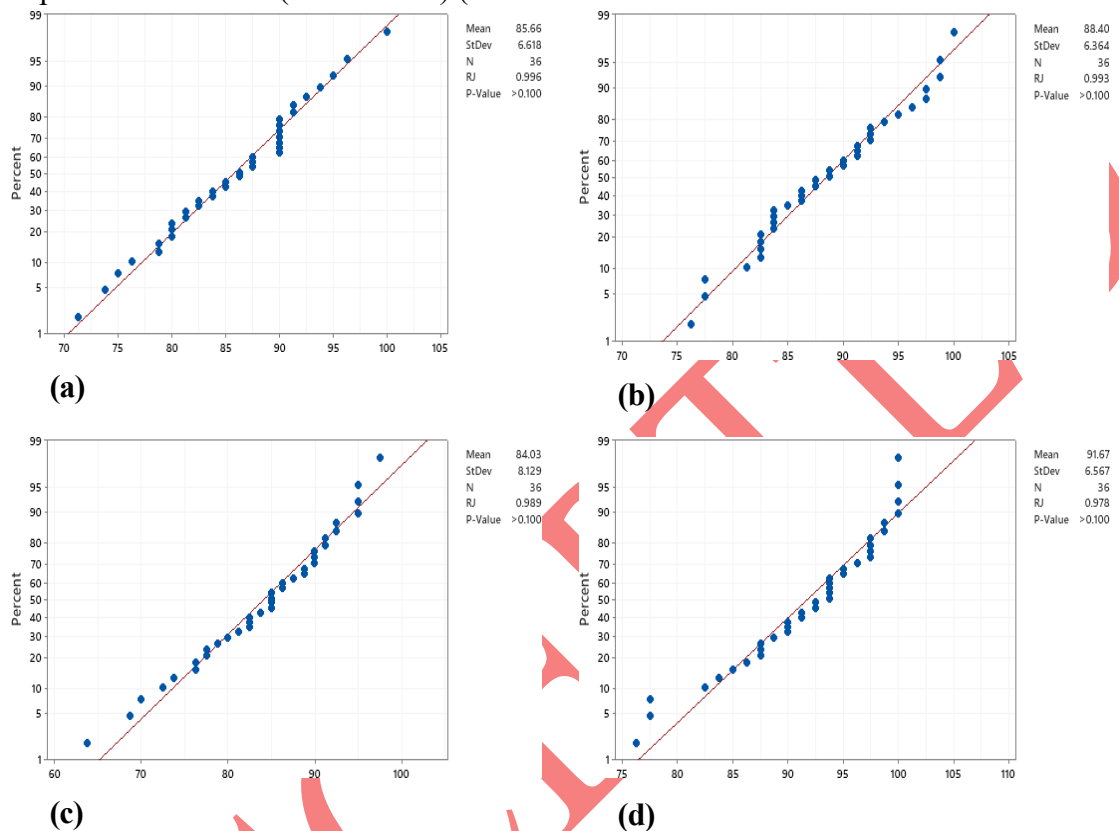


Figure (1): Normal distribution of questionnaire: a. control class (pre-test), b. experimental class (post-test), c. control class (post-test), d. experimental class (post-test).

Homogeneity Test: The homogeneity test was used to assess whether the data originated from the same population (Kim, 2019). Table 6 shows that the P-value obtained from Levene's test was 0.903, which is well above the significance level of 0.05. This result indicates that the questionnaire data were homogeneous, suggesting they originated from the same population.

Table (6): Homogeneity Test Result.

Sample	Significance (α)	Lavene test (P-value)
Control Class	0.05	0.903
Experimental Class		

3. E-comic Effectiveness Test

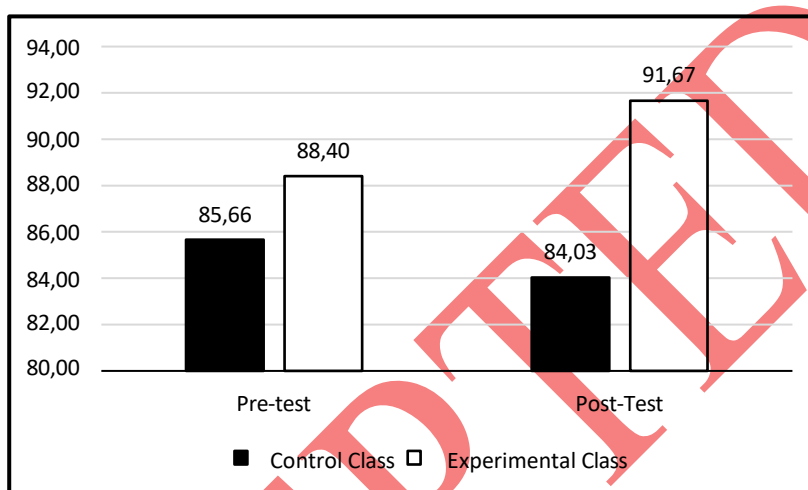
Statistical Analysis: The results from the pre-test and post-test questionnaires met the necessary

assumptions for conducting a T-test, namely normal distribution and homogeneity of variance (Susrianty *et al.*, 2024). A t-test was conducted to examine the difference in mean questionnaire scores between the control and experimental groups. As shown in Table 7, the resulting P-value was 0.077, which exceeds the significance threshold of 0.05. This suggests that there was no statistically significant difference between the two groups. In other words, the tolerance levels in the control and experimental classes were comparable at the outset.

Table (7): T-test of Pre-test Questionnaire.

Sample	N	Average	Standard Deviation	Significance (α)	P-value
Control Class	36	85.66	6.62		
Experimental Class	36	88.40	6.36	0.05	0.077

Figure 2 illustrates a noticeable increase in the experimental class's average score following the use of e-comics. This improvement is supported by the P-value in Table 8, which falls below the significance level, indicating a meaningful difference between the pre-test and post-test scores. Thus, the upward trend shown in Figure 2 aligns with the statistical findings presented in Table 8.

**Figure (2):** Average score of questionnaire.**Table (8):** Comparison of pre-test and post-test experimental classes.

Sample	N	Average	Standard Deviation	Significance (α)	P-value
Pre-Test	36	88.40	6.36	0.05	0.026
Post-Test	36	91.67	6.57		

Table 9 shows a P-value below the established significance level, indicating a significant difference in post-test average scores between the experimental and control

classes. This finding further supports the conclusion that the use of e-comics contributed to the improvement in the experimental class's performance.

Table (9): Comparison of control and experimental classes post-test.

Sample	N	Average	Standard Deviation	Significance (α)	P-value
Control Class	36	91.67	6.57	0.05	0,000
Experimental Class	36	84.03	8.13		

As shown in Figure 2, the control class's average scores remained relatively consistent between the pre-test and post-test. This observation is supported by the T-test results in

Table 10, where the P-value exceeded the significance value. This indicates that there was no significant difference in the control class's scores before and after the intervention.

Table (10): Comparison of pre-test and post-test control classes.

Sample	N	Average	Standard Deviation	Significance (α)	P-value
Control Class Pre Test	36	84.03	8.13	0.05	0.354
Control Class Post Test	36	85.66	6.62		

Figure 2 clearly illustrates that the use of e-comics had a positive impact on students'

tolerance attitudes. The rise in the experimental class's average score following the

implementation of e-comics as a learning tool highlights their effectiveness in fostering more tolerant behavior. This finding aligns with previous studies, which suggest that improvements in tolerance can be measured through shifts in the average questionnaire scores at the class level (Armawinda *et al.*, 2022; Daniati *et al.*, 2023).

The use of e-comics as teaching materials has been found to increase students' motivation and interest in the subject (Anggraeni *et al.*, 2023; Bukian *et al.*, 2024; Fitria *et al.*, 2023; Turan & Ulutas, 2016). The student's motivation and interest were key factors in achieving satisfactory learning outcomes (Ernawati *et al.*, 2022; Snigdha & Moriom Akter, 2023). Therefore, the improvement in students' tolerance attitudes can be largely attributed to the heightened interest and motivation sparked by the use of e-comics in the learning process.

In several studies, the effectiveness of using e-comics has been assessed solely through increases in average class scores and questionnaire outcomes (Bukian *et al.*, 2024; Turan & Ulutas, 2016). However, this study used the T-test to compare the classes' average scores. The use of the T-test aimed to increase the accuracy of determining the effectiveness of e-comics (Hanusz *et al.*, 2016). The

effectiveness of e-comics in improving students' tolerance attitudes are consistent with several literature, who demonstrated that interactive digital media can enhance students' motivation and learning outcomes (Al-Aziz *et al.*, 2025; Monaem & Aljarousha, 2024).

Analysis of Tolerance Indicators: A more granular analysis of the pre-test and post-test results revealed that the effectiveness of the e-comic varied across different indicators of tolerance. Indicators such as "appreciation for diversity" (indicators 2) and "willingness to forgive" (incicators 10) showed the most significant improvement. This suggests that visual and narrative approaches are particularly effective in influencing interpersonal and affective components of tolerance.

Conversely, indicators related to "avoiding negative prejudice" (indicators 3) and "critical understanding of intolerance causes" (indicators 5) showed relatively smaller gains. This discrepancy indicates that while e-comics are effective in influencing emotional responses and basic values, they may require supplementary activities (such as guided discussions or critical debates) to address deeper cognitive dimensions of tolerance. These findings point to the need for integrating e-comics with structured classroom interaction to maximize their impact.

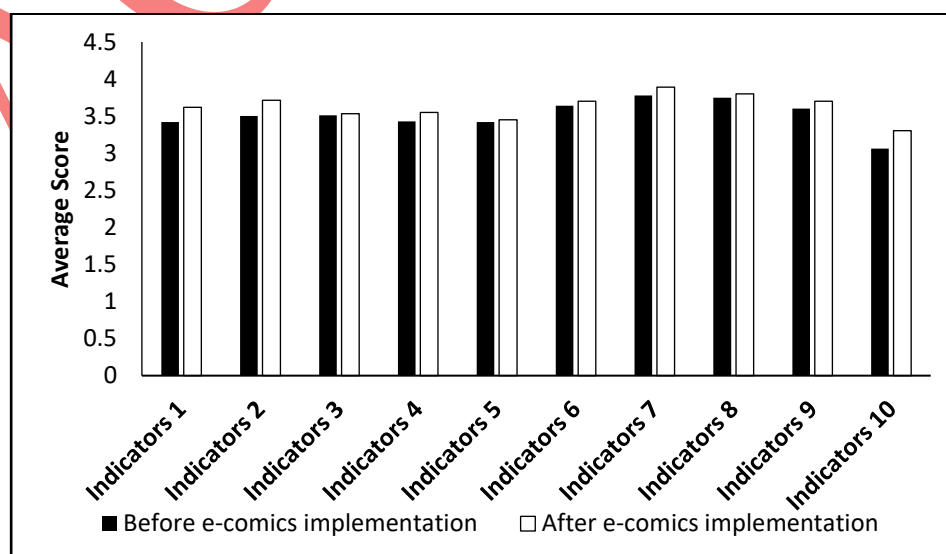


Figure (3): Comparison of the Value of Each Indicator before and after e-comic treatment.

Relationship between Constructivist Learning Theory and E-Comic Implementation: Implementing e-comics as a companion teaching material showed the application of constructivism learning theories. This learning theory model stresses the autonomy of students in comprehending the material. The effectiveness of using e-comics demonstrated the advantages of this learning theory model in influencing students' implementation attitudes (Romadhoni, 2025).

Constructivism posits that learners actively build their own understanding and knowledge of the world through experiences and reflection on those experiences (Sahin & Yilmaz, 2020). In this approach, knowledge isn't simply handed down from teacher to student; rather, it is actively built by learners through their interactions with the environment, their peers, and the learning resources around them. E-comics, by design, offer a dynamic, contextual, and student-centered experience. The visual narratives in e-comics depict relatable scenarios, conflicts, and resolutions that reflect real-life social and moral dilemmas. When students interact with the storylines and characters, they are not just reading passively—they are interpreting the narrative, predicting outcomes, empathizing with characters, and making judgments. These mental processes are at the heart of constructivist learning (Taber, 2024).

Furthermore, the interactivity and visual appeal of e-comics stimulate both cognitive and affective aspects. When students interpret visual cues, dialogue, and events in the comic, they construct mental models of social behavior, ethical decision-making, and conflict resolution. These models get strengthened through the emotional engagement that e-comics uniquely evoke; students experience what the characters feel, leading to the internalization of the conveyed values.

In Civic Education, where abstract values such as tolerance, empathy, and respect take center stage, the constructivist use of e-comics enables students to engage with these concepts through rich, narrative experiences. Rather than merely memorizing definitions or moral guidelines, learners are placed in immersive scenarios that invite them to "live" tolerance through the eyes of the characters. This experiential approach encourages deeper comprehension and promotes meaningful, lasting changes in attitude. (Alt, 2018).

Moreover, when e-comics are combined with collaborative learning methods like Problem-Based Learning (PBL), they create a dynamic space for discussion, debate, and shared exploration. Students work together to analyze the moral dilemmas presented in the comics, suggest possible solutions, and consider the consequences of their choices. This interactive process highlights the social nature of learning and aligns with Vygotsky's constructivist theory, which underscores the critical role of cultural and social contexts in shaping cognitive development.

In summary, e-comics bring constructivist principles to life by placing students at the heart of the learning process, engaging them through both visual and verbal modes, and encouraging active meaning-making. When integrated into Civic Education, they transform abstract moral concepts into tangible, student-centered explorations of values. As a learning medium, e-comics align closely with the core tenets of constructivist learning theory. Constructivism suggests that learning is an active process in which individuals form their own understanding by engaging with the world around them and reflecting on those experiences. Rather than simply absorbing information passed down from a teacher, students construct knowledge through meaningful interactions with their

environment, classmates, and educational resources.

Comparative Literature Study: Over the past decade, e-comics have attracted growing interest in educational research, particularly as educators look for creative tools that engage both the mind and the heart. While most recent studies have focused on the cognitive advantages of digital comics across various subjects, this study expands the conversation by highlighting their emotional impact specifically, their potential to nurture civic values like tolerance.

For instance, Indriana *et al.* (2024) showed that e-comics effectively improved students' understanding of disaster mitigation concepts in high schools. Their study emphasized the visual-narrative synergy in helping students internalize abstract emergency protocols through story-driven scenarios (Indriana *et al.*, 2024). Likewise, Serevina *et al.* (2021) found that science-themed digital comics played a valuable role in supporting distance learning, particularly for complex topics like global warming. The combination of visuals and narrative structure helped boost student engagement and made it easier for them to grasp difficult concepts (Serevina *et al.*, 2021).

Moving beyond the realm of science, Yulaichah *et al.* (2024) discovered that e-comics designed around a realistic mathematical approach enhanced elementary students' critical and creative thinking skills. Their study suggests that embedding math problems within relatable storylines helps students connect abstract concepts to real-life situations, making the material more meaningful and applicable (Yulaichah *et al.*, 2024). In a broader educational context, Mahartini and Tristananda (2025) examined the use of digital comics to support character education in elementary schools. Their study revealed notable gains in students' empathy and ability to work collaboratively, highlighting the medium's potential to foster

positive social behaviors from an early age (Mahartini & Tristananda, 2025).

Anggito and Sartono (2022) explored the use of comics in promoting tolerance-based learning within multicultural classrooms. Their findings showed that students became more thoughtful and open-minded, demonstrating a greater appreciation for diversity and differing perspectives (Anggito & Sartono, 2022). This supports the findings of the present study, emphasizing that e-comics function not just as tools for cognitive development, but also as powerful affective mediums that connect knowledge with core values.

Unlike much of the existing literature that tends to focus narrowly on knowledge gains or engagement levels, this study takes a more rigorous approach by using statistical analysis (T-tests) to measure meaningful shifts in students' tolerance attitudes. By grounding its findings in quantitative validation, the study offers stronger evidence of e-comics' impact on the affective domain, addressing a notable gap in current research on educational media.

In summary, this study builds on and extends previous research by showing that when e-comics are crafted with intentional, value-driven narratives, they can promote more than just academic engagement. They can also cultivate meaningful social attitudes in learners. The visual and emotional appeal of comics uniquely positions them to support character education, particularly in areas like tolerance, empathy, and intercultural understanding.

4. Practical Implications for Educators and Policy Makers

This study offers meaningful practical insights. For educators, integrating e-comics into civic education can make moral and civic values more engaging and relatable. E-comics may serve as tools for discussion, reflection, and assessment, provided teachers are trained

to guide students in critically interpreting their messages. For policymakers, the findings highlight e-comics as a cost-effective and scalable medium for strengthening character education. With the widespread use of digital devices among students, investing in e-comic development across subjects could help promote key 21st-century skills such as empathy, global citizenship, and critical thinking.

5. Study Limitations and Directions for Future Research

Although this study provides important insights, several limitations should be acknowledged. Conducted in a single school, the results may not be fully generalizable to broader contexts. The research measured tolerance through self-reported questionnaires, which may not fully capture actual behavioral expressions of tolerance. Moreover, factors such as students' prior exposure to diversity, socio-cultural backgrounds, or cognitive differences were not controlled and could have influenced the outcomes. The study also focused on short-term effects, suggesting the need for longitudinal research to examine the sustainability of attitude changes. Future studies could adopt mixed-method approaches—such as interviews or focus groups—to gain deeper understanding of students' interpretations of e-comics. Exploring their application in varied educational contexts, including multicultural or conflict-prone settings, and involving students in e-comic co-creation may further enhance civic learning and engagement.

Conclusion

Tolerance is crucial for the development of high school students. A method to foster tolerance among kids is via civics education. Conventional instructional resources in civics education frequently exhibit monotony, ineffectiveness, and a deficiency of originality.

This study seeks to create e-comics as extra instructional tools to improve the achievement of educational objectives. The use of e-comics as educational tools seeks to improve students' tolerance levels.

Assessment of e-comics by material and media specialists revealed a superior quality level. Consequently, e-comics may be employed for educational purposes in the classroom. The mean score on the questionnaire for the experimental group rose subsequent to the use of e-comics as educational resources. Consequently, e-comics have been successful in improving pupils' views toward tolerance. Numerous T-tests validate the effectiveness of e-comics in improving attitudes toward tolerance. These tests clarify the differences in average post-test scores between the control and experimental groups, the post-test and pre-test scores within the experimental group, and the stability of pre-test and post-test scores within the control group.

This study represented the preliminary stage in the development of instructional materials demonstrated to improve students' attitudes about tolerance. This study is limited by a small sample size and fails to consider the variable of student intellect. Future research may be undertaken on a larger scale, accounting for the many intelligence variables of students to improve their views towards tolerance. Furthermore, utilizing e-comics is a viable option for instructing additional courses in the future, particularly for content that requires an interactive methodology and storyline to enhance student comprehension.

Disclosure Statements

– **Ethical Approval and Content to Participate:** This study was conducted in accordance with the ethical standards of research involving human participants. Ethical approval was obtained from the

Ethics Committee of Universitas Sebelas Maret, under approval number 20317/UN27.02/PK.03.08/2024.

Permission to conduct the study was granted by the local education authority under approval number 800.2/1279. Prior to data collection, participants were informed about the objectives, procedures, and voluntary nature of the study. Written consent was obtained from both the students and their parents/guardians. All data were collected anonymously and used solely for research purposes. Participants were assured that their responses would remain confidential and that they could withdraw from the study at any time without any academic or personal consequences.

- **Availability of data and materials:** The datasets generated and analyzed during the current study are not publicly available due to institutional policies protecting participant privacy but are available from the corresponding author on reasonable request. The e-comic learning materials developed in this study, along with the research instruments (questionnaires and validation sheets), can be accessed for academic and non-commercial purposes by contacting the corresponding author via email at luthfiadevi23@student.uns.ac.id. All data used in this research were collected, processed, and stored in accordance with ethical standards to ensure confidentiality and integrity.
- **Author Contribution:** The first author, Luthfia Devi Romadhoni, was responsible for conducting the research, developing the e-comic learning materials, collecting and analyzing the data, and writing the manuscript. The second author, Triyanto, served as the primary thesis supervisor who provided academic guidance, valuable feedback, and approval of the final manuscript. The third author, Triana

Rejekiningsih, acted as the secondary supervisor who contributed through supervision, constructive suggestions for improvement, and final approval of the paper prior to submission. All authors have read and approved the final version of this manuscript.

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