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Development of Digital Comics Based on Culturally Responsive Teaching (CRT) to Improve Multicultural Competence and Sustainability Literacy

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ABSTRACT

Integrating the concepts of nature and the times into learning is a crucial foundation for creating education that is relevant to students' needs and current developments. Learning in accordance with nature, which takes into account student characteristics and instills social and cultural values, can support the development of multicultural competencies and sustainability literacy. Learning in accordance with the times facilitates the use of digital technology in learning media. The study aims to develop a digital comic based on *Culturally Responsive Teaching* (CRT) to improve multicultural competence and sustainability literacy in elementary school students. The method used is Research and Development (R&D) with the ADDIE model. The research design used was a one-group pretest-posttest. The research subjects were 30 fourth-grade students at an elementary school in Bogor Regency. The results of expert validation showed that the media was in the very feasible category, with 100% of media experts, 97% of material experts, and 98% of language experts. The results of the N-Gain test showed an increase in multicultural competence of 0.5825 and sustainability literacy of 0.6430 in the moderate category. Teacher and student responses indicated that the media was very practical. Thus, digital comics grounded in Culturally Responsive Teaching (CRT) are deemed feasible and practical for learning and highly effective in improving multicultural competence and sustainability literacy. This media can be an alternative solution for teachers in creating learning that is contextual and relevant to students' lives.

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1. INTRODUCTION

Education is an effort to increase students' abilities and potential to form their character. According to Ki Hadjar Dewantara, education is guidance to raise meaningful children; student growth does not depend on ability or the teacher's wishes. Student growth and development depend on their abilities, which are shaped by nature and time. The law of

nature and the law of time are the basis for the runway on which Ki Hadjar Dewantara delivers education.

The law of nature emphasizes the importance of harmony between human beings and the universe, while the law of time highlights the need to adapt education to changing times. Integrating the concepts of the law of nature and the law of time into the educational curriculum concept has profound implications for efforts to strengthen the relevance and effectiveness of education in Indonesia [1]. Instilling cultural values based on the natural order of things means that teachers facilitate student learning in line with students' characteristics and needs. Learning is shaped by the times; ideally, teachers design and implement learning that is appropriate to the times. Learning must instill social and cultural character values so that students can face global challenges and apply their knowledge and experience in their daily lives. values characterized by competence, multiculturalism and literacy sustainability.

Multicultural competence is the ability to understand, appreciate, and interact effectively with individuals from diverse cultures, thereby supporting individual development in a multicultural environment [2], [3]. Multicultural competence is an individual's ability to accept, respect, and collaborate with people who are different from them[4]. Multicultural competence is an awareness of student diversity, culture, traditions, and adopted cultural values, as well as self-involvement in multicultural development in schools, which is very important for prospective elementary school teachers [5].

Multicultural competence refers to the ability to appreciate differences and collaborate effectively in diverse environments, making it essential in the global era. Multicultural competence can be defined as the ability to recognize and appreciate students' diverse cultural backgrounds, along with a commitment to providing equal educational opportunities for all. Its development can be achieved by integrating stories, history, and examples from various cultures, leveraging technology, and implementing a variety of learning strategies that reflect students' diverse characteristics [6]. Multicultural competence relates to students' attitudes, knowledge, and skills. Multicultural competence is essential for students to develop character and life skills in the global era, enabling them to compete globally. Another competency that students must possess to face 21st-century competition is sustainability literacy. Multicultural competence and sustainability literacy are interrelated and complementary.

Sustainability literacy is the ability to encompass knowledge, skills, attitudes, and understanding to be aware of economic, social, and environmental issues and to take decisions and actions that support the creation of a sustainable future [7], [8], [9], [10]. Sustainability literacy is a set of knowledge, skills, and mindsets that encourage individuals to commit and make appropriate decisions in realizing a sustainable future [11], [12].

Sustainability literacy is a set of knowledge, skills, and ways of thinking that support individuals in committing to realizing a sustainable future and making wise decisions to achieve it. Sustainability literacy is a skill a person must possess to live sustainably. This includes the ability to evaluate problems, formulate solutions, and act sustainably. Sustainability literacy must be developed in learning activities.

Based on the ANBK results in 2025, one school in Bogor Regency experienced a 5.39% decline in the diversity climate indicator. The diversity climate indicator is closely related to multicultural competence and sustainability literacy. These results indicate that multicultural competence and sustainability literacy have not improved significantly.

The decline in diversity occurs because learning factors are not adapted to students' life contexts, and learning media are not used optimally. This is reinforced by the results of learning observations from six elementary school teachers at a public elementary school in Bogor Regency. Based on the learning observation analysis, the utilization of media and learning resources is not optimal. Obtained a percentage of 51%, so it is in the lower category. The results of the observation show that teachers have used learning media, but their utilization is not optimal, especially in media that involve students actively, interactively, and in a variety of ways.

The observation results on the learning material aspect showed a percentage of 62% in the least category. The observation results show that the learning material is quite appropriate to the learning objectives and students' needs; however, improvements are needed to better in the material to students' daily lives.

Based on the ANBK results and learning supervision, innovations are needed to connect material to students' life contexts and to utilize more varied, interactive, and relevant learning media in the learning process. These learning innovations are expected to improve students' multicultural competence and sustainability literacy.

Sustainability literacy and multicultural competency can be integrated into Pancasila education lessons, particularly those on ethnic and socio-cultural diversity. Ethnic and socio-cultural diversity can be defined as a condition in society characterized by differences in various fields, including knowledge, beliefs, arts, customs, and habits. According to Widiastusi (2013), Indonesia's ethnic and socio-cultural diversity arises from its society comprising groups with distinctive ethnic characteristics [13]. Ethnic and socio-cultural diversity is the diversity inherent in a society, each with its own unique characteristics. Ethnic and socio-cultural diversity in Indonesia encompasses ethnic groups, languages, clothing, customs, beliefs, and arts. Ethnic and socio-cultural diversity is studied in Phase B of Pancasila Education in the fourth grade of elementary school.

Learning about ethnic and socio-cultural diversity should utilize a context-based learning approach relevant to students' lives. One approach is *Culturally Responsive Teaching* (CRT). *Culturally Responsive Teaching* (CRT) focuses on developing 21st-century skills and creating relevant and meaningful learning experiences by linking them to students' cultural backgrounds. This approach values diversity, creates a fun learning environment, and fosters an appreciation for differences in the classroom [14]. Gloria Ladson-Billings states that Culturally Responsive Teaching (CRT) focuses on utilizing students' culture as a foundation for learning. Three key elements of Culturally Responsive Teaching (CRT) are cultural competence, developing positive relationships between teachers and students, and creating relevant and meaningful learning experiences. According to Geneva Gay, Culturally Responsive Teaching (CRT) is an approach that requires teachers to understand and appreciate students' cultural values [15].

Culturally Responsive Teaching (CRT) creates learning experiences that are relevant to students' lives, encourages active participation, and increases motivation to learn. *Culturally Responsive Teaching* (CRT) places students at the center of the learning process, taking into account the cultural contexts in which they learn. Through CRT, students understand the values of diversity through learning experiences in relevant cultural contexts [6]. The Culturally Responsive Teaching (CRT) approach can increase student engagement by contextualizing learning within students' cultural contexts, using authentic cultural artifacts, and creatively integrating media and technology. This approach consistently contributes to improved academic achievement across a variety of subject areas, supporting active participation, collaboration, and multicultural awareness [16].

Learning using the Culturally Responsive Teaching (CRT) approach can improve multicultural competence. This is in line with research conducted by [6] on the Integration of Culturally Responsive Teaching Approach, Local Wisdom, and Gamification in Pancasila Education to Develop Students' Multicultural Competence. The research produced a learning syntax based on Culturally Responsive Teaching (CRT). This model syntax includes interactions between cultural engagement, self-understanding, cultural technology, collaboration, reflection, and evaluation.

Learning about ethnic and socio-cultural diversity using *the Culturally Responsive Teaching* (CRT) approach will be effective using technology-based learning media. One suitable learning medium for cultural diversity material is digital comics. Ethnic and socio-cultural diversity is important to learn about through media appropriate to the context and needs of students in elementary schools.

Digital comics are illustrated stories featuring characters presented through electronic media, arranged sequentially to convey meaningful information and messages [17], [18], [19]. Digital comics are comics published in digital format, consisting of a series of interconnected images, and are interactive with stories produced using digital technology [20], [21].

Based on these definitions, it can be concluded that digital comics are illustrated stories that feature characters with meaning in messages for the reader, created and presented using digital technology such as computer software, laptops and mobile phones. Digital comics present material through visual illustrations, stories, simple dialogue, and contextual situations that align with the cognitive development of fourth-grade elementary school students. Digital comics can increase students' attention, motivation, and engagement in learning. Learning becomes more interactive, engaging, and easier to understand. This means that digital comics can increase student engagement and attention. According to Jean Piaget's theory of cognitive development, elementary school students aged 7–11 are in the concrete operational stage, in which children more easily understand concepts through real objects, images, and everyday experiences. At this stage, children begin to think logically about concrete things, but still have difficulty understanding abstract concepts [22].

Extensive research on digital comics has shown that they can improve elementary school students' learning outcomes and increase their interest and motivation to learn. Furthermore, research on culturally responsive learning approaches has shown that culture-based learning can increase students' engagement and abilities across diverse cultures.

However, previous research has largely focused on digital comics as a comprehensive learning medium. It has not specifically integrated the principles of Culturally Responsive Teaching (CRT) into the development of multicultural competencies and sustainability literacy in Pancasila Education, particularly in the subject of ethnic and socio-cultural diversity in fourth-grade elementary schools.

Digital comics have a visual format that makes them suitable as a learning medium for elementary school students. Digital comics can enhance multicultural competencies and sustainability literacy. The visuals used in digital comics can be adapted to the surrounding culture. Therefore, digital comics can be created in line with Culturally Responsive Teaching (CRT). The principles of Culturally Responsive Teaching are embedded in the design of digital comics through the presentation of stories, characters, language, and illustrations that reflect students' culture and everyday lives. Digital comics are designed to showcase the diversity of ethnicities, languages, customs, and habits in students' environments, making the learning material more relevant and meaningful. Furthermore, digital comics include reflection, collaboration, and problem-solving activities that encourage students to appreciate differences, work together, and develop a concern for the environment and sustainability. The use of interactive digital technology also supports students' active involvement in the learning process in line with the characteristics of CRT-based learning.

Based on this, the researcher will conduct a study entitled "Development of Digital Comics based on *Culturally Responsive Teaching* (CRT) to Improve Multicultural Competence and Sustainability Literacy ." The research objective is to produce digital comics based on *Culturally Responsive Teaching* (CRT) to improve multicultural competence and sustainability literacy.

2. METHOD

This research used a development method, or *Research and Development* (R&D). The R&D research used the ADDIE model. The ADDIE Branch Model consists of *Analysis, Design, Development, Implementation, and Evaluation [23]*. The analysis phase involved analyzing educational report cards, curriculum, teacher observations, interviews, and student questionnaires to identify learning needs related to multicultural competency and sustainability literacy. The analysis focused on indicators of a climate of diversity, learning materials, and the need for engaging, interactive, and contextual media. The design phase included developing a schedule, designing a digital comic based on Culturally Responsive Teaching (CRT), and developing research instruments. The comic was designed with a contextual storyline that showcases cultural diversity and incorporates the values of multicultural competency and sustainability literacy.

Furthermore, instruments were developed, including observation sheets, questionnaires, expert validation, and pre- and post-test questions. The development phase involved creating a digital comic in Medibang Paint and Canva, then presenting it as a flipbook in FlipHTML. The product was then validated by experts, tested with the question instruments, and piloted with students and teachers to determine the practicality of using the digital comic. The implementation phase involved implementing the CRT-based digital comic in teaching materials on ethnic and socio-cultural diversity. At this stage, pre-tests

and post-tests were conducted to measure student competency improvement, and questionnaires were distributed to assess the media's appeal and usefulness. The evaluation phase involved analyzing data using IBM SPSS 19 and Microsoft Excel. The results were used to answer the research questions and draw conclusions regarding the success of the CRT-based digital comic in improving students' multicultural competency and sustainability literacy. The research design used was a one-group pretest-posttest. The research was conducted in class IV at a State Elementary School in Bogor Regency with 30 students as research subjects.

The data in this study were collected using observation, interviews, questionnaires, and tests. The instruments used were a lesson observation sheet, a media needs questionnaire, a teacher interview sheet, an expert validation sheet, pre-test and post-test questions, and a student practicality questionnaire. The data collection techniques used were qualitative and quantitative. The data analysis techniques in this study were sourced from qualitative data in the form of interview results, as well as validation by media, material, and language experts. The analysis results were then used as the primary basis for revising and refining the digital comic in line with *Culturally Responsive Teaching* (CRT).

The quantitative data analysis technique for this research is based on expert validation questionnaire data, teacher and student responses, and *pre-test* and *post-test results*. The product's suitability was validated by three experts: a media expert, a materials expert and a language expert. Eligibility for the digital comic-based *Culturally Responsive* Teaching (CRT) was measured using a Likert scale with five interpretations: Very Poor (1), Poor (2), Fair (3), Good (4), and Excellent (5) [24]. The data collected using the expert validation questionnaire were subsequently analyzed quantitatively using percentage analysis. Product feasibility criteria were based on converting scores to percentages, in accordance with Arikunto (2010), and were then interpreted into qualitative categories using a modified five-point Likert scale ranging from "very unfeasible" to "very feasible" [25].

$$P = \frac{Data\ Collection\ Score}{Ideal\ Score}\ x\ 100$$

Table 1. Digital Comic Eligibility Criteria

Percentage 0%	Criteria
0-20	Very Infeasible
21-40	Not Feasible
41-60	Moderately Feasible
61-80	Feasible
81-100	Highly Feasible

After being calculated, the validation results listed in the expert validation sheet will be analyzed using the following formula [26]:

$$CVR = \frac{ne - \left(\frac{N}{2}\right)}{N / 2}$$

Information:

n_e = number of experts who agreed on the item as relevant.

N = Total Number of experts who assessed

CVR Interpretation:

- If CVR ≥ 0.99, the item is very valid
- If CVR ≥ 0.67, the item is valid
- If CVR < 0.67, the item needs revision.

From the CVR calculation, *the Content Validity Index* (CVI) will be obtained. The CVI calculation uses the following formula [27]:

$$CVI = \frac{(\sum CVR)}{K}$$

Information

K = Number of Items

The following are the CVI calculation categories [27]:

Table 2. CVI Calculation Categories

Range	Category
0-0.33	Not appropriate
0.34-0.67	Appropriate
0.68-1	Very appropriate

Improvement in competence in multiculturalism and literacy sustainability, measured through an analysis of the *Pre-test* and *Post-test*. Analysis results *from the pre-test and Post-test* use application *IBM SPSS 19*. Through normality tests, the Wilcoxon test, and the N-Gain test.

A normality test is performed to determine whether the research data are normally distributed. The normality test is performed on the Sig score from the *Shapiro-Wilk calculation*. If the *Sig value is > 0.05*, the data distribution is normally distributed. whereas if *sig < 0.05*, the data distribution is not normal[28]. If the data are normally distributed, further calculations are carried out using parametric tests; if they are not, nonparametric tests, such as the Wilcoxon test, are used.

The *Wilcoxon Signed Rank Test* is used to analyze paired data from two groups to determine whether there are significant differences between them. This test is typically used when the data is not normally distributed or on an ordinal scale [29]. The Wilcoxon Signed-Rank test is used to determine whether there is a difference between pre-test and post-test results in paired data that is not normally distributed. This is done by looking at the significance value (asimp. significance or p-value) in the statistical output. If the significance value is less than 0.05, then there is a significant difference between the pre-test and post-

test scores, so it can be concluded that the treatment or use of learning media has an impact on improving student learning outcomes. Conversely, if the p-value is greater than 0.05, the treatment has no significant effect. Furthermore, positive and negative ranking results can indicate the direction of change. A positive ranking indicates an increase in post-test scores compared to the pre-test, while a negative ranking indicates a decrease in scores [30].

The Gain Test was conducted to determine the effectiveness of digital comics based on *Culturally Responsive Teaching* (CRT) in improving multicultural competence and sustainability literacy by analyzing the difference between *the Pre-test* and *Post-test* using the following formula [31]:

$$N - Gain\ (g) = \frac{Posttest\ Score - Pretest\ Score}{Maximal\ Posttest\ Score - Pretest\ Score}$$

Table 3. *N-Gain Value Criteria*

N-Gain	Improvement Criteria
G > 0.7	High Improvement
0.5 ≤ G ≤ 0.7	Moderate Improvement
G ≤ 0.5	Low Improvement

Table 4. *N-Gain* Effectiveness Interpretation Categories

Percentage (%)	Interpretation
< 40	Ineffective
40 – 55	Less effective
56 – 75	Quite Effective
>76	Effective

Teacher and student responses aimed to determine the practicality of digital comics in *Culturally Responsive Teaching* (CRT). The following is a formula for calculating the practicality of digital comics [25]:

$$Practical\ Level = \frac{Studend's\ Score}{Total\ Score}\ x\ 100$$

Table 5. Practicality Criteria for Digital Comics

Average Score Interval	Classification
81% - 100%	Very Practical
61% - 80%	Practical
41% - 60%	Quite Practical
21% - 40%	Less practical

3. RESULTS AND DISCUSSION

3.1. Result

Eligibility digital comic based on *Culturally Responsive Teaching* (CRT) views from results validation media, material, and language experts. The validation results were calculated based on percentage feasibility, CVR, and CVI, indicating that the digital comics developed fulfil the criteria for validity and eligibility as a learning medium. This is suitable for use in school-based learning activities, as it can support a more engaging, contextual, and

meaningful learning process for students. The following is a diagram of the results validation expert.

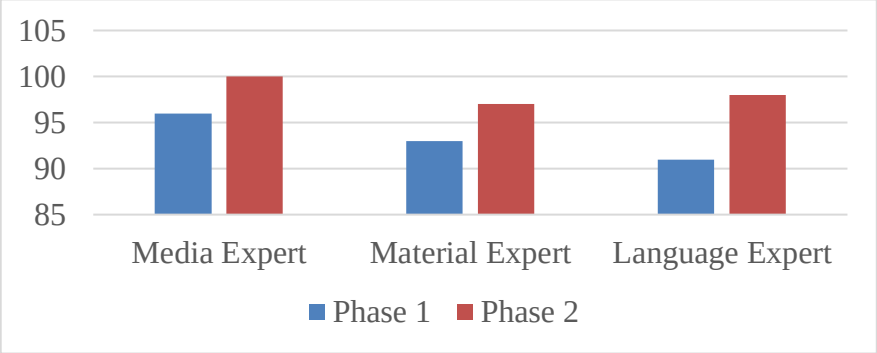

Figure 1. Percentage of Feasibility Results Digital Comic Expert Validation

Validation results from experts show that all indicators are over target for aspects such as stories, images, messages conveyed, characters, and digital forms, with experience improvement ranging from 96% to 100% and a maximum average of 5. If converted to in criteria, its eligibility, namely "Very Eligible," can be used as a medium in activity learning.

CVR is calculated using the Likert scale, with 1 (essential) and 0 (not essential). The scale from 1-3 is converted to score 0 with the criterion 'No essential', whereas the scale 4-5 is converted to score 1 with the criterion 'essential'. Based on the table results validation by media experts, the CVR result of 1.00 is interpreted as the "Very Valid" category. The CVI of 1.00 indicates that the media validity is in the very appropriate range. Based on results validated by media experts, digital comics based on Culturally Responsive Teaching (CRT) are assessed on their own channel, clear story, attractive visuals, strong message, and ease of use and distribution.

Based on the results assessment by material experts, the improvement percentage increased from 93% to 97%, with the part indicator receiving the maximum mark of 5 and the number of indicators receiving a value of 4. Suppose interpreted with the criteria, eligibility is categorized as "Very Eligible" in the material aspect. The following is a suitable digital comic image, as per expert validation assessment.

The CVR calculation result of 1.00 is interpreted as a "Very Valid" category. The CVI calculation result of 1.00 indicates that digital comic media is based on expert validation, namely in the "Very Appropriate" category. Referring to the results evaluation validation expert material, it can be stated that digital comic media, based on *Culturally Responsive Teaching* (CRT), is very appropriate implemented as a learning medium with a little on some part as improvement.

Figure 2. Digital Comics

Based on the language expert's evaluation, there was an improvement in the percentage from 91% to 98%. The large indicator received the maximum mark, 5, with one of the indicators receiving a value of 4. In terms of straightforwardness, all indicators receive a value of 5. Sentences used have represented the material presented; the language used is simple and appropriate, in accordance with the existing rules in the Big Indonesian Dictionary. This proves that the language aspect of Culturally Responsive Teaching (CRT) in digital comics has been developed and is in the "Very Eligible" category.

The resulting CVR of 1.00 indicates that digital comic-based Culturally Responsive Teaching (CRT) has already been assessed in essential by expert validators, with the CVR interpretation "Very Valid". The CVI value is based on results validation; namely, 1.00 indicates a "Very Good" level of validation. Referring to the results validation expert language, the language aspects in the culturally responsive teaching (CRT) developed are very appropriate, valid, and appropriate for use in activity learning.

Based on the results of the normality test in the Shapiro-Wilk output table, the pre-test sig. was 0.114 and the post-test sig. was 0.001. A pre-test value of 0.114 is greater than 0.05, thus concluding that the values are normally distributed. A post-test value of 0.001 is less than 0.05, thus concluding that the values are not normally distributed. Based on these conclusions, the analysis continued using the nonparametric Wilcoxon test.

The Wilcoxon test results show an average difference of 14.00 between the pre-test and post-test scores. Based on the Test Statistics Output table, the Asymp Sig. (2-tailed) of 0.000 is less than 0.05. Therefore, it can be concluded that there is a significant difference between the pre-test and post-test scores, indicating that the use of Culturally Responsive Teaching (CRT)-based digital comics has an impact on students' multicultural competence. Based on the N-Gain calculation, the average N-Gain Score was 0.5825. This value falls within the range of $0.5 \leq G \leq 0.7$, thus categorizing as moderate improvement. This indicates that the use of digital comics based on Culturally Responsive Teaching (CRT) can significantly improve student learning outcomes. Furthermore, the average N-Gain Percentage was 58.2485%. When interpreted based on the effectiveness assessment category, this value falls within the range of 56–75%, indicating it is moderately effective.

Based on these calculations, it can be concluded that the developed digital comics grounded in Culturally Responsive Teaching (CRT) are highly effective in improving elementary school students' multicultural competence. This is also consistent with the Wilcoxon test results, which showed a significant difference between pre-test and post-test scores, thus confirming that the media used has a positive impact on improving multicultural competence.

Based on the normality test results in the Shapiro-Wilk output table, the Pre-test Significance value was 0.002, and the Post-test Significance value was 0.001. These significant results indicate that the scores are not normally distributed, so the analysis continued using a nonparametric test, the Wilcoxon test.

The Wilcoxon test results showed an average difference of 14.00 between the pre-test and post-test scores. Based on the Output Test Statistics table, the Asymp Sig (2-tailed) of 0.000 is less than 0.05. It can be concluded that there is a difference between the pre-test and post-test results, indicating that the use of Culturally Responsive Teaching (CRT)-based digital comics has an impact on students' sustainability literacy.

Based on the analysis, the average N-Gain Score was 0.6430. According to the N-Gain value criteria, this value falls within the range $0.5 \leq G \leq 0.7$, indicating a moderate improvement. This indicates that the use of the developed learning media can significantly improve student learning outcomes. Furthermore, the average N-Gain Percentage value was 64.2980%. When interpreted based on the effectiveness assessment category, this value falls within 56–75%, placing it in the moderately effective category.

Thus, it can be concluded that the learning media developed capability improves literacy sustainability in the moderate category and is classified as sufficiently effective in its use. Results show that the media used had a positive effect, though it can be further developed to achieve greater reach and effectiveness. Teacher and student responses were collected from a questionnaire on the practicality in using digital comics. Response results are analyzed based on the percentage. The following diagram shows the percentage of teacher and student responses.

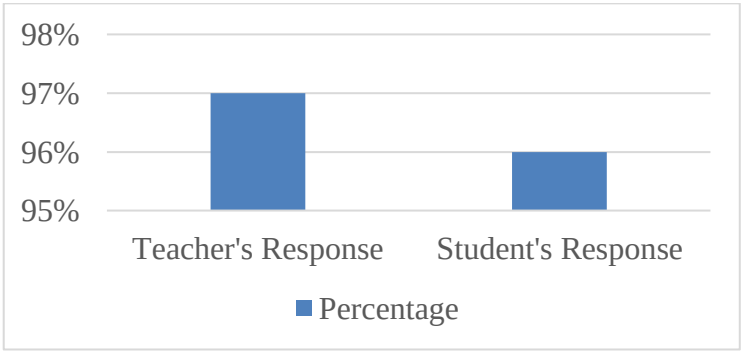

Figure 3. Teacher and Student Response Results

Based on the questionnaire results, teacher responses to the practicality of the digital comic-based Culturally Responsive Teaching (CRT) yielded in overall average score of 4.8, with a percentage of 97%. This result shows that digital comic-based *Culturally Responsive*

Teaching (CRT) was developed in the very practical category for use as a medium in activity learning, especially on the material diversity ethnic group, nation and society culture.

Overall, the questionnaire results show that the digital comic-based Culturally Responsive Teaching (CRT) has a very high level of practicality. This media is not only easy to use but also effective in conveying material that is interesting and engaging, helping to improve students' multicultural competence and literacy, as well as their sense of social justice and sustainability. Based on the results, the result is 48.1 out of 50. The level of practicality of the digital comics developed reached 96%. This value shows that, in a sense, students in general give very positive assessments of the learning media used.

If analyzed further, the average score obtained for each grain statement is in the range of 93.3% to 100%. This indicates that almost all aspects assessed, such as convenience of use, clarity of materials, visual displays, and suitability of content to student characteristics, received very good responses. The height values for each indicator also show that digital comics can capture student attention and facilitate optimal learning.

Referring to the criteria practicality that has been determined, namely in the interval 81%–100% categorized as "very practical", then the percentage by 96.2%, including in the very practical category. This means that the digital comic-based Culturally Responsive Teaching (CRT) was developed to a very high level of practicality and can be easily used by students with little or no experience or without significant obstacles.

In addition, the results show that digital comic media is not only visually interesting but also effective in helping students understand the material. The use of Culturally Responsive Teaching (CRT) connects material to students' daily lives, contributing to increased convenience, use and meaning in learning. Thus, it can be concluded that the digital comic-based Culturally Responsive Teaching (CRT) developed has fulfilled the criteria for practicality, with a very practical category. This media is worth using in the learning process in school-based settings because it can provide an engaging experience, facilitate easy learning and be appropriate to students' needs and characteristics.

3.2. Discussion

Based on the validation results from material, language, and media experts, the developed digital comic was categorized as very suitable. This indicates that the product meets the material, language, and media display aspects appropriate to the characteristics of elementary school students.

Referring to the expert validation results, in addition to its interactive presentation, the digital comic also has engaging visuals and a coherent storyline. This aligns with the multimedia learning theory proposed by Mayer in [32], which states that related text and images should be presented simultaneously, closely spaced and temporally close. This can help students process visual and textual information more optimally, thus making it easier for them to understand the material presented.

The material in the digital comic on Culturally Responsive Teaching aligns with learning outcomes and objectives and integrates the Culturally Responsive Teaching (CRT) approach. The material presented is deemed relevant to students' lives and accommodates cultural diversity. This aligns with research by [33], which states that Culturally Responsive

Teaching (CRT) can make learning more contextual, meaningful, and relevant for students by linking the material to their own experiences and cultural identities. The stages of Culturally Responsive Teaching (CRT) are integrated into dialogue, storylines, and character interactions to align better learning with students' cultural experiences. Digital comic design is carried out by composing a contextual and relevant storyline for students' lives, through conflicts about ethnic and socio-cultural diversity, arranged sequentially from character introduction, the emergence of conflict, problem-solving, and moral messages that convey multicultural competence and sustainability literacy. The characters in the comic are designed to represent cultural diversity through distinctive characteristics, speaking styles, and habits, and to demonstrate positive attitudes such as mutual respect and cooperation.

The language used in digital comics grounded in Culturally Responsive Teaching (CRT) is clear and easy to understand. The use of simple, contextually relevant language makes it easier for students to understand the message, thereby reducing misunderstandings [34]. Digital comics are interactive multimedia that facilitate students' understanding of the material presented. Research conducted by [35] found that learning using interactive multimedia based on Culturally Responsive Teaching (CRT) that integrates local cultural elements can produce engaging, contextual, and meaningful learning.

Based on the research results, the digital comic media developed using Culturally Responsive Teaching (CRT) is quite effective in improving the multicultural competence of elementary school students, although the improvements achieved have not yet reached a high level. Competence in multicultural experience improvement in each indicator. The development of a digital comic on Culturally Responsive Teaching (CRT) has been shown to increase students' understanding of diversity in their surrounding environment. With a contextual story, it is easier for students to in material to daily life. This is in line with James A. Banks' opinion in [36] that understanding diversity culture is very important for education multiculturalism since it creates attitudes and abilities in an inclusive society. Enhancing multicultural competence through the development of digital comics based on Culturally Responsive Teaching (CRT) is a concrete implementation of multicultural education. Research by [37] indicates that multicultural education, grounded in constructivist theory, emphasizes active, adaptive, and contextual learning processes. This digital comic medium is an effective tool that emphasizes active, adaptive, and contextual learning. Digital comics facilitate students' construction of knowledge about diversity through activities relevant to real life. Students actively understand stories that represent their cultural diversity, thereby enhancing multicultural competence.

The increase in multicultural competence in this study is in line with research that has been conducted by [6], Integration of Culturally Responsive Teaching Approach, Local Wisdom, and Gamification in Pancasila Education to Develop Students' Multicultural Competence. The research subjects were fifth-grade students at elementary schools in Bogor City. The study found that the Pancasila education learning model based on Culturally Responsive Teaching (CRT), integrated with local wisdom and gamification (CERITALOGAM), was feasible and effective in developing students' multicultural competence. Other relevant research included [38], which focused on module project

learning to make traditional food from Bogor to increase competence in multiculturalism and global diversity.

Based on the research results, the digital comics learning media developed using Culturally Responsive Teaching (CRT) were found to improve students' sustainability literacy in the moderate category and were considered quite effective in their use. These results indicate that the learning media make a positive contribution in helping students' understanding of sustainability concepts, although the improvement has not yet reached the high category.

Sustainability literacy must be enhanced in students to address global change. This can be facilitated by using various learning methods, approaches, and media [7]. Literacy sustainability experience improvement, although in the moderate category, is classified as 'Enough effective in its use. This result indicates that the learning media's own contribution is positive in helping students understand sustainability concepts, although the increase in the Not yet reached category of high literacy sustainability is not yet very significant. This is in line with the draft Education for Sustainable Development put forward by UNESCO in [39], which emphasizes the importance of developing student competencies in understanding and addressing global problems in general terms. The increase in sustainability literacy is in line with research conducted by [40], which found that this research can make a small contribution to increasing sustainability literacy.

The use of digital comics based on Culturally Responsive Teaching (CRT) in learning has been proven quite effective in improving students' multicultural competence and sustainability literacy. The CRT approach emphasizes connecting learning materials to students' cultural backgrounds to make learning more contextual, meaningful, and inclusive. This is in line with research by [41], which shows that incorporating local culture into learning can increase students' engagement and creative thinking skills, especially in terms of flexibility and fluency in the idea-generation process.

The improvement in multicultural competence and sustainability literacy was in the moderate category. This study involved only 30 students in one elementary school, and the sample size was only 30. Due to the short implementation time of the media, the results cannot be widely generalized, and students did not receive in-depth or repeated learning experiences. Furthermore, students' prior understanding of sustainability and cultural diversity influenced their learning outcomes. Continuous learning is necessary to understand the concept of sustainability, which encompasses environmental, social, and cultural elements. Therefore, educational digital comics grounded in Culturally Responsive Teaching (CRT) are expected to improve students' multicultural skills and sustainability literacy consistently.

Digital comic media-based Culturally Responsive Teaching (CRT) was developed at its own level, with very high practicality as evidenced by student and teacher responses. This media is not only easy to use and interesting, but also capable of creating fun, contextually relevant learning that is relevant to student life. Therefore, this media is very useful in the learning process to support improvement, involvement, motivation, and optimal student understanding. This finding is in line with research conducted by [42], which shows that the

use of educational comics in learning can increase students' understanding and interest in learning, especially when linked to a cultural context.

Digital comic media-based culturally r*esponsive teaching* (CRT) is relevant with a number of findings, studies like [43], development of learning media digital comics on the eyes lesson knowledge, social for fifth-grade students of the school base in Bogor City, with results eligibility expert material and language with "good" category, whereas results ligibility validation media expert with "good" category. Research was furthermore carried out by [44], the development of learning media digital comics in cargo education, Pancasila material diversity and social culture in Indonesia, with results that are eligible with very suitable criteria.

Research entitled "Development of Digital Comics to Improve Learning Outcomes on Pancasila Values Material for Fourth Grade Elementary School Students by [45] with results showing very valid eligibility. Research, furthermore, namely by [46], focused on the development of digital comics to strengthen the profile of Pancasila students in the Pancasila education subject for class V.

Other relevant research that is research conducted by [47], "Development of Digital Comic Media based on Canva Pro Application to Increase Ability Communication between Culture of fourth grade students of Hanura Bina Putra Elementary School, "with criteria valid/feasible. Research conducted by [48] on the Development of Digital Comics about Bhinneka Tunggal Ika and Pancasila for students at school-based settings, with results showing very high eligibility.

Both encourage students to appreciate diversity and work together, as well as to have social, cultural, and environmental awareness in everyday life. Sustainability literacy and multicultural competence are interrelated. The Culturally Responsive Teaching (CRT) learning approach integrates sustainability literacy and multicultural expertise into the educational process, resulting in learning that is contextual, inclusive, and relevant to students' lives. However, this study has several limitations. These include the short implementation time, the limited sample size in a single elementary school, and the use of a One-Group Pretest-Posttest design without a control group. In addition, this study only concentrated on material related to ethnic and socio-cultural diversity in fourth-grade elementary schools.

4. CONCLUSION

Based on the results of research on the development of digital comics based on *Culturally Responsive Teaching* (CRT) to improve multicultural competence and sustainability literacy, it can be concluded that:

The feasibility of digital comics grounded in Culturally Responsive Teaching (CRT) to improve multicultural competence and sustainability literacy is supported by validation results from media, material, and language experts. Media experts validated the product with a value of 100%, CVR and CVI 1.00; material experts validated the product with a value of 97%, CVR and CVI 1.00; and language experts validated the product with a value of 98%, CVR and CVI 1.00. Based on the validation results, the language aspect in the digital comic

developed using Culturally Responsive Teaching (CRT) is feasible, valid, and appropriate for use in learning activities.

Multicultural Competence Enhancement: After using digital comics based on Culturally Responsive Teaching (CRT), there was a statistically significant increase in the average Pre-test and Post-test scores of 14.00. This is reinforced by the N-Gain score of 0.5825, which is in the moderate improvement category. The N-Gain Percentage of 58.2485% is interpreted as being in the quite effective category. Based on these calculations, it can be concluded that the developed digital comics grounded in Culturally Responsive Teaching (CRT) are highly effective in improving elementary school students' multicultural competence.

The improvement in sustainability literacy after using digital comics based on *Culturally Responsive Teaching* (CRT) statistically showed an average increase of 14.00 *in the Pre-test* and *Post-test*. This is reinforced by the N-Gain score of 0.6430, which is in the moderate increase category. The N-Gain Percentage of 64.2980% is interpreted in the moderately effective category. Based on the statistical results, the developed digital comics based on *Culturally Responsive Teaching* (CRT) can provide an increase in sustainability literacy in the moderate category and are classified as quite effective in their use.

Teacher responses after completing the questionnaire on the practicality of *Culturally Responsive Teaching (CRT)-based digital comics yielded an overall average score of 4.8, with a 97% response rate*. These results indicate that the developed *Culturally Responsive Teaching* (CRT)-based digital comics are highly practical for use as a medium in learning activities, particularly on the topic of ethnic and socio-cultural diversity.

Students' responses after using *Culturally Responsive Teaching (CRT)-based digital comics resulted in an overall average score of 48.1 out of a possible 50, with a 96.2% success rate*. The developed *Culturally Responsive Teaching* (CRT)-based digital comics met the practicality criteria, categorized as very practical.

This media can be an alternative solution for teachers in creating learning that is contextual and relevant to students' lives.

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