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Developing CRT-Based Comic Media to Improve Climate Change Management Education in Elementary School Students

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Abstrak: Climate change is a global challenge that impacts human life and the environment, which requires effective education, especially for the younger generation. This research aimed to develop comic media as an educational tool to address climate change through the Culturally Responsive Teaching (CRT) approach, with a focus on disaster mitigation for elementary school students. This study implemented a Research and Development (R&D) method using the ADDIE model and was conducted with fourth-grade students at SDIT Bunaya, Bogor with 20 students as the participants. The results showed that the average student understanding of climate change before the learning process was 72.25, which increased to 91.75 after the intervention. These findings indicate that the use of comic media effectively enhances students' understanding of climate change and disaster mitigation, while also fostering caring attitudes toward the environment. Moreover, the comic media provides an engaging, interactive, and contextual learning experience. It not only improves students' environmental literacy but also serves as a culturally relevant science education tool that supports sustainable development.

Keywords: Climate change education; Comic media; Culturally Responsive Teaching; Disaster mitigation.

Introduction

The issue of climate change and global warming has now become a concern for all countries in the world. Addressing climate change and promoting sustainable development is part of the Sustainable Development Goals (SDGs). According to Silfia (as cited in Malihah, 2022), climate change can be understood as a change in temperature conditions and weather patterns over a long period of time. Climate change can threaten the continuation of human life. One of the obstacles in efforts to overcome the impacts of climate change is the lack of knowledge among several related parties about the natural phenomena that occur as a result of global warming. Therefore, the community must play an active role in addressing climate change through adaptation and mitigation efforts (Ainurrohmah, 2022).

According to the Intergovernmental Panel on Climate Change (IPCC, 2022) report, there was a significant increase in the amount of greenhouse gas (GHG) emissions in the atmosphere from 1990 to 2019. This increase in greenhouse gas emissions has caused climate change. In addressing this phenomenon, the education sector is one of the important elements that plays a role in providing climate change education to the community (Shahzad & Riphah, 2015; Yanuar, 2023). Therefore, education on handling climate change needs to be provided from an early age in elementary schools.

Based on the results of interviews with elementary school teachers in Bogor, knowledge about climate change has been introduced to students by integrating it into certain subjects such as science and social studies. The learning resources used in studying climate change are still limited to textbook readings. In addition,

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students have not received information from other media or through outreach programs conducted by external parties. Counseling related to mitigation efforts in Bogor has been limited to disaster mitigation activities. This is largely due to Bogor's high rainfall, which makes the area prone to flooding and landslides. However, disaster mitigation cannot be separated from climate change mitigation and adaptation, as recent disasters have been significantly influenced by climate change (Banholzer, 1984). Given the importance of providing climate change education to students, efforts must be made to deliver information in ways that are appropriate, effective, efficient, and meaningful for students.

Based on the problem of climate change education for elementary school students in Bogor, one effort that can be made is the development of disaster mitigation comic media based on Culturally Responsive Teaching (CRT). This media can serve both as educational and instructional material, which is expected to enhance students' knowledge of climate change management in Bogor. In facing the challenges posed by climate change, education plays a critical role in promoting climate action among school-aged students through both formal and informal learning (UNESCO, 2013). Climate change education is an integral part of the Education for Sustainable Development (ESD) program. It is a major issue that must be taught and understood by students so that future generations possess the attitudes, knowledge, and skills necessary to adapt and thrive amidst the dynamic challenges caused by climate change (UNESCO, 2012).

According to Corder, Centeno, and Todd (2020), efforts to improve climate change management can be carried out through education for students, which represents one form of an Integrated Science approach that enhances students' problem-solving abilities. Similarly, Andriyani (2020) emphasizes that providing education has a positive effect on students' knowledge, as it fosters awareness and develops critical thinking skills to prepare the younger generation to face climate change challenges. Educating the younger generation provides a foundational understanding for managing and utilizing natural resources wisely and sustainably, thereby helping to minimize global warming, which has a direct impact on climate change (Hadi, 2023). The ongoing commitment to mitigating climate change must be upheld by stakeholders at various levels, including individual, collective, community, and government (Junarto, 2023).

Buchari (2020) views that disaster mitigation is an initial effort to prevent disaster risks. In line with this, Husna (2019) argues that disaster mitigation education is effective in increasing preparedness for natural disasters. Public communication about the risks of climate change is also important, as messages conveyed to society can raise awareness and promote proactive behavior to prevent such risks (Patrianti, 2020). One form of communication for students on climate change adaptation is through disaster mitigation comic media (Yunsi, 2020). Research by Aulia (2022) has shown that developing valid and practical disaster mitigation comic media for third-grade elementary school students is effective. Similarly, Nasrullah (2021) developed comic media to improve children's understanding of flood disaster preparedness. Comic media about the Karimun Jawa Islands includes narrative text, illustrations of tourism potential (since Karimun Jawa has been designated as a UNESCO biosphere reserve), and comic characters wearing traditional clothing that reflect the local multiethnic context (Priyangga, 2023). Local wisdom, which consists of beliefs and ancestral customs, reflects environmental awareness in specific regions. It encompasses sociological, theological, and cosmological perspectives and can be integrated with CRT in comic media to support climate education (Yacoubian, 2018).

Based on the preliminary studies above regarding efforts to improve climate change management, there remains a gap in the integration of culturally relevant content into science-based media for climate education at the elementary level. No existing studies have systematically developed disaster mitigation comics grounded in students' cultural contexts and used as a tool for science instruction. Comic media can serve as an alternative for teachers to diversify instructional materials and enhance students' knowledge of climate change management. This type of media supports the development of scientific attitudes, improves material retention, and creates a more engaging and enjoyable learning experience for students. Hence, this research aims to address that gap by developing comic media through the CRT approach, with a focus on disaster mitigation for elementary school students.

Method

The development of a CRT-based disaster mitigation comic for Grade IV students at SDIT Bunaya in Bogor City was conducted using the Research and Development (R&D) method, following the ADDIE model (Analyze, Design, Development, Implementation, and Evaluation). This study involved 20 students as participants and employed a one-group pretest-posttest design to measure changes in their knowledge of climate change management. The instrument used to assess students' understanding was a climate change comprehension test. Validity testing was conducted by both media and material experts. Research data were analyzed using both quantitative

and qualitative descriptive methods. Field trials were implemented on a limited scale using the same one-group pretest-posttest design to assess students' level of knowledge regarding climate change management. This design can be described as follows:

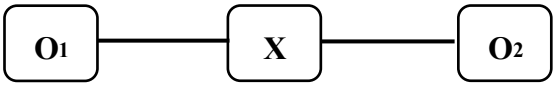

Figure 1. One-group Pretest-posttest Design

Description:
O_1 = Pretest given before using comic media
X = Treatment using comic media
O_2 = Posttest given after using comic media

The product developed in this study was a learning media in the form of a disaster mitigation comic based on the CRT approach. The development process began with a preliminary study to explore how climate change management had been introduced to students in the context of disaster preparedness. This step was followed by an analysis of the learning process in schools, including the models and media that were used, and whether teachers had previously delivered material related to climate change management. Based on the findings, the comic media were designed and developed, then validated by the content and media experts on a limited scale. During the development stage, the comics were implemented in classroom learning to observe their impact on students' knowledge of climate change management. The final stage involved evaluation through student response questionnaires and teacher feedback as media users. The stages of comic media development followed the ADDIE model, as illustrated in Figure 2.

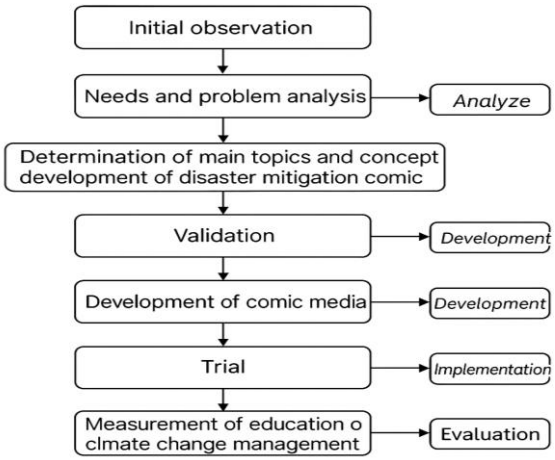

Figure 2. Stages of Developing the CRT-Based Disaster Mitigation Comic Using the ADDIE Model

Result And Discussion

Result

The development of the CRT-based disaster mitigation comic followed the ADDIE model. At the Analyze stage, the results of a preliminary questionnaire indicated that students had a 58% level of understanding of climate change. In addition, observations of learning outcomes and indicators were conducted to inform the design of the comics. During the Design stage, an initial layout and content structure for the CRT-based disaster mitigation comics were developed. The initial design is presented in Figure 3.

Figure 3. Initial Design of the CRT-based Disaster Mitigation Comic

After completing the Design stage, the process continued to the Development stage. At this stage, the teaching material was transformed into a comic product, which was then evaluated for its feasibility by a media expert validator. The results of this assessment are presented in Figure 4.

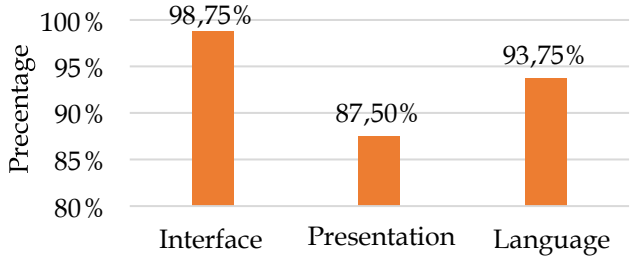

Figure 4. Tabulation of Media Expert Validation Result

Additionally, the result of the material expert validation are depicted in Figure 5 and served as the basis for assessing the content quality and relevance of the developed comic media.

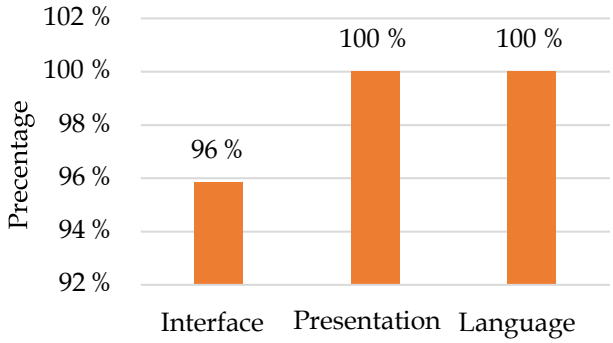

Figure 5. Tabulation of Material Expert Validation Result

Based on the tabulation of media expert validation result (Figure 4), the interface aspect received a score of 98.75%, the presentation aspect 87.50%, and the language aspect 93.75%, resulting in an overall average score of 96.43%. According to Arikunto (2013), this score falls within the "very feasible" category. In addition, figure 5 presents the result of the material expert validation, showing interface at 96%, presentation at 100%, and language at 100%, with an average total score of 97.50%, which also falls within the "very feasible" category. The validation of the questionnaire instrument indicated a high level of validity, categorized as "very valid."

The CRT-based disaster mitigation comic was tested on grade IV students at SDIT Bunaya, Bogor City. The implementation involved a pretest, followed by the learning process using the developed comic, and concluded with a posttest. The results demonstrated a 26.5% increase in students' understanding of climate change. The effectiveness level of the comic media is presented in Table 1.

Table 1. Calculation of N-gain value

Average Score		N-Gain Value
Pretest	Posttest	
52690	64155	0.53

Discussion

Indonesia is one of the countries with the highest risk of natural disasters in the world and is located between three of the world's tectonic plates, namely the Indian-Australian Ocean plate, the Pacific Ocean plate, and the Eurasian plate, which causes various disasters to arise, such as flash floods and erosion in several areas (Sulistiawan et al., 2022). Natural disasters can occur unpredictably; this condition makes people surprised and unprepared to face them. This lack of preparedness is due to insufficient public knowledge about disaster readiness. Readiness behavior refers to activities or actions taken in response to a disaster with appropriate measures, supported by both physical and psychological capabilities. The importance of improving students' understanding of climate change is critical because schools are strategic places to develop their potential in disaster risk reduction. However, to enhance students' understanding of climate change in relation to disasters, appropriate tools are needed, one of which is the use of effective learning media.

The research on CRT-based disaster mitigation comic development was conducted using the ADDIE model (Analyze, Design, Development, Implementation, Evaluation). The first stage began with an analysis through field studies and literature reviews. Field studies were carried out through observations and interviews at SDIT Bunaya, Bogor City. Based on interviews with teachers, it was found that efforts to introduce disaster mitigation related to climate change had been made during lessons. However, the media used consisted only of PowerPoint slides and images, which were insufficient to support learning in the digital era. After the analysis and data collection stages, the second stage was designing, which started with the preparation of the material structure and content for the comic. This was followed by designing an attractive layout and format to assist students understand the content more easily and develop interest in disaster-related topics. The result of this stage was a draft of the comic, which was prepared for testing. The evaluation tool in the form of pretest and posttest essay questions was also developed and validated by experts before being implemented in the trial. The third stage was the development phase, initiated after the draft comic was completed. In this stage, the comic was validated by three experts—two media experts and one material expert—to assess the feasibility of the media in terms of content, design, and clarity. The purpose of this validation was to gather feedback and suggestions to ensure the effectiveness and efficiency of the material before its use in field research. This validation stage is a crucial part of the design process, followed by expert evaluations to finalize the product.

Based on the validation results, all three assessment aspects met the criteria of being very feasible, with percentage scores exceeding 80%. Both the language and presentation aspects received the highest scores of 100%, attributed to the use of clear, accessible language and engaging presentation, which effectively captured students' interest. This aligns with the findings of Manurung et al. (2021), who argue that easy-to-understand language and well-designed interface can enhance students' reading engagement and comprehension. The content aspect received a score of 95.83%, contributing to an overall average of 97.50%, which falls within the "very feasible" category. According to Arikunto (2013), a percentage score between 81% and 100% is considered valid and feasible. In addition, instrument validation was conducted by distributing questionnaires to students who were not part of the research sample to ensure their reliability.

The product that had been validated and revised was subsequently implemented in the fourth stage, namely the implementation stage. The CRT-based disaster mitigation comic media, having passed expert validation, was ready for field testing. A limited trial was conducted in an experimental class using a one-group pretest-posttest research design within a single meeting. The learning process consisted of administering a pretest, delivering instructional material, facilitating discussions, presenting discussion outcomes, and administering a posttest. Following the trial, the average pretest score was 72.25%, while the posttest score increased to 91.25%, indicating a high category. These results demonstrate that students' readiness behavior improved from moderate to high, with a 19% increase and an average N-gain of 0.53, categorized as moderate (quite effective). These findings align with Yanti & Fauzi (2022), who state that improvements in pretest and posttest scores reflect increased student responsiveness to natural disasters. The comic media was integrated throughout the learning process and served as a reference to enhance students' understanding of climate change and to foster disaster preparedness behaviors. This supports the assertion of Khair & Fauzi (2022), who argue that such media effectively enhances attitudinal competencies linked to student knowledge.

One of the key indicators of disaster preparedness is knowledge. When the knowledge acquired is insufficient, the impact of disasters can become significantly more severe. Therefore, understanding climate change needs to be taught from an early age. Knowledge about disasters influences students' attitudes in facing them. This is in line with the opinion of Setyawati (2014) who stated that students' knowledge generally affects the attitudes and concerns of the community. Delivering knowledge to students becomes more effective when supported by suitable teaching materials. Interactive and innovative learning media can increase students' interest and motivation, helping them to better grasp information. The CRT-based disaster mitigation comic implemented during teaching and learning activities is beneficial in stimulating students' thinking, interest, and motivation, which encourages effective educational communication.

After completing the implementation stage, the product entered the final phase of the ADDIE model, namely the evaluation stage. This phase involved collecting data through response questionnaires administered to students and teachers after using the CRT-based disaster mitigation comic. The average score from student responses was 86.72 percent, while the overall score from teacher responses was 95.83 percent, both of which fall into the very feasible category. The responses from teachers and students indicated that the CRT-based disaster mitigation comic media was highly interesting and easy to understand.

These findings confirm that CRT-based disaster mitigation comics are effective learning media in enhancing students' knowledge and preparedness for disasters. The visual and narrative elements of comics not only attract students' attention but also support comprehension of complex scientific concepts related to climate change and disaster mitigation. Visual media significantly improves cognitive processing by combining verbal and visual stimuli. Moreover, embedding cultural relevance within the content strengthens students' connection to the material as the culturally responsive teaching approach increases their engagement and understanding in science education. This research is in line with those of Priyangga (2023), who reported that disaster-themed comic media increased elementary students' environmental awareness, and Nasrullah (2021), who found that integrating local disaster contexts into visual learning tools enhanced science learning outcomes. Similarly, Yunsi (2022) highlighted that comics rooted in local culture improved students' attitudes and behaviors toward disaster preparedness. Therefore, it can be concluded that the comic media developed in this research successfully strengthens students' understanding of climate change and fosters a readiness to face disasters, thus demonstrating its validity and effectiveness as a culturally responsive science learning tool.

Conclusion

Based on the results and discussion on the development of the CRT-based disaster mitigation comic to improve education about climate change, it is

evident that the comic is valid and suitable for use in schools. The validation results from media experts yielded a percentage of 96.43 percent and from material experts 97.50 percent, both of which fall into the very valid category. Students' understanding of climate change during the pretest scored 72.25 percent in the moderate category, while posttest results increased to 91.75 percent in the high category. The percentage increase of 26.5 percent and an average n-gain of 0.53 indicate that the comic is quite effective in improving student learning outcomes. The student response questionnaire received an average score of 86.72 percent, while the teacher response reached 95.83 percent, showing that the media is very well received and practical for use in classroom learning. This CRT-integrated comic can serve as a prototype for contextualized science instructional tools in elementary education, especially in regions vulnerable to climate change impacts.

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Author Contributions

Conceptualization, writing—original draft preparation, Indri Yani and Lungguh Halira; validation and revision, M. Taufik; translation and proofreading, Indirwan.

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References

Ainurrohmah, S., & Sudarti, S. (2022). Perubahan iklim dan pemanasan global. *Jurnal Pendidikan Fisika dan Teknologi*, 8(1). http://dx.doi.org/10.22373/p-jpft.v3i3.13359

Andriyani, Ernyasih, & Srisantyorini, T. (2020). Edukasi adaptasi perubahan iklim dalam perspektif Islam pada mahasiswa program studi kesehatan masyarakat Fakultas Kesehatan Masyarakat Universitas Muhammadiyah Jakarta (PSKM FKM UMJ). *Muhammadiyah Public Health Journal*, 1(1), 2–10. https://doi.org/10.24853/mphj.v1i1.7023

Banholzer, S., Kossin, J., & Donner, S. (1984). *The impact of climate change on natural disasters. In Z. Zommers & A. Singh (Eds.), Reducing disaster: Early warning systems or climate change*. Germany: Springer Science+Business Media Dordrecht.

Buchari, R. A. (2020). Manajemen mitigasi bencana dengan kelembagaan masyarakat di daerah rawan bencana Kabupaten Garut Indonesia. Sawala: *Jurnal Pengabdian Masyarakat Pembangunan Sosial, Desa dan Masyarakat,* 1(1), 1–10. https://doi.org/10.24198/sawala.v1i1.25836

Corder, E. C., Centeno, D., & Todd, A. M. (2020). The role of climate change education on individual lifetime carbon emissions. *PLOS ONE,* 15(2), e0206266. https://doi.org/10.1371/journal.pone.0206266

Hadi, S., Taqiudin, M., Anggara, D., Mujahadah, N., & Mulyadi, P. N. (2023). Pengetahuan generasi muda terhadap fenomena perubahan iklim. *Jurnal Tampiasih,* 2(1), Desember.

Husna, C., Hafni, M., Fithria, J., & Jannah, S. R. (2019). Efektivitas edukasi mitigasi bencana terhadap kesiapsiagaan bencana gempa bumi dan tsunami pada keluarga pasien di rumah sakit. *Idea Nursing Journal,* 10(1), 21–26. https://doi.org/10.24815/jts.v%25vi%25i.14174

Junarto, R. (2023). Climate change mitigation and impacts of agrarian resource management: Insights from Indonesia. *Tunas Agraria,* 6(3), 237–254. https://doi.org/10.31292/jta.v6i3.219

Malihah, L. (2022). Challenges in overcoming the impact of climate change and supporting sustainable economic development: A review. *Jurnal Kebijakan Pembangunan,* 17(2), 219–232. https://doi.org/10.47441/jkp.v17i2.272

Nasrullah, Y., Akbar, Z., & Supena, A. (2021). Pengembangan media komik untuk meningkatkan pemahaman kesiapasiagaan bencana banjir pada anak. Jurnal Obsesi: *Jurnal Pendidikan Anak Usia Dini,* 6(2), 832–843.

Patrianti, T., Shabana, A., & Tuti, R. W. D. (2020). Komunikasi risiko pemerintah pada penurunan emisi gas rumah kaca untuk mengatasi perubahan iklim. *Jurnal Penelitian Komunikasi dan Opini Publik,* 24(2), 156–170.

Priyangga, B., Mushafanah, Q., Listyarini, I., & Kristanti, D. N. (2023). Pengembangan komik dengan pendekatan culturally responsive teaching untuk menumbuhkan literasi sains pada kelas V SDN Kalicari 01 Semarang. *Jurnal Kridatama Sains dan Teknologi,* 5(1). https://doi.org/10.53863/kst.v5i01.705

Shahzad, U., & Riphah. (2015). Global warming: Causes, effects and solutions. *Durreesamin Journal,* 1(4).

UNESCO. (2012). *Education for sustainable development sourcebook*. France: United Nations Educational, Scientific and Cultural Organization.

UNESCO. (2013). *Climate change education*. United States: United Nations Educational, Scientific and Cultural Organization.

Yacoubian, H. A. (2018). Scientific literacy for democratic decision-making. *International Journal of Science Education,* 40(3), 308–327. https://doi.org/10.1080/09500693.2017.1420266

Yunsi, Y. (2022). Pengembangan komik mitigasi bencana berbasis CRT alam di Pekanbaru untuk siswa sekolah dasar SDN 21 Pekanbaru. *Jurnal Guru Kita,* 6(2), 117–127. https://doi.org/10.24114/jgk.v6i2.33444