



Develop Comics as Learning Media to Improve Students' Knowledge about Environmental Disaster in Biology Learning

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Abstract: The development of innovative learning media is an alternative to solving problems that occur in the learning process, especially for students in biology learning. For this reason, an innovation in learning is needed to increase students' knowledge about environmental disasters and the handling of various types of environmental disasters through environmental disaster comics. The research method used is Research & Development (R&D) and uses the ADDIE development model (Analyze, Design, Development, Implementation, and Evaluation) with a one group pretest - posttest research design. The subjects in this study were class VII students of MTs Ar-Ridho Sentul. The research instrument used was in the form of multiple-choice questions and questionnaire sheets. Data analysis techniques include assessing creative thinking skills which are measured using the N-Gain formula. The results of the data analysis showed that the students' knowledge increased significantly. This indicates that project-based learning comic-based learning media is able to increase students' knowledge. In addition, the response of teachers and students also gave positive results that learning media in the form of comic project based learning can help increase knowledge of environmental disaster mitigation.

Keywords: Disaster; Environment; Students

Introduction

The location of Indonesia's territory is prone to environmental disasters because it is located in the Pacific ring of fire (Dewi & Dartanto, 2019; Shalihati et al., 2016; Tyler & Sadiq, 2018). Indonesia has been continuously dealing with earthquakes, tsunamis and volcanic eruptions. In the last 20 years, Indonesia has made headlines in the media because of the environmental disasters it experienced or a long rainy season could destroy rice harvests of Indonesian farmers. Indonesia has also experienced environmental disasters caused by human activity itself, for example, not far from forest fires, because of the human habit of burning fields and eventually spreading to other fields. Throughout 2019 Indonesia was hit by earthquakes which were considered the most destructive environmental disasters in the Indonesian region.

During the rainy season floods usually disrupt distribution channels and therefore Indonesia tends to experience inflationary pressures during January and February when the rainy season tends to peak. Wet conditions can be exacerbated by the La Nina weather phenomenon.

La Nina (basically the opposite of El Niño), is a phenomenon that occurs on average once every five years, bringing cooler-than-average ocean temperatures to the tropical central and eastern Pacific Ocean. This results in wetter than usual weather in Southeast Asia, usually from November to February. Apart from that, Indonesia has always had very heavy rains, to be precise in the area of West Java, rain has been flushing in several cities in West Java which has resulted in minor or flash floods, therefore in an environmental disaster must have a reason why the disaster happened (Mulyandari, 2011; Renggono, 2017).

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Floods and landslides occur in many parts of Indonesia and can cause hundreds of casualties, destroy homes and other infrastructure, and cause losses to local businesses. Even in megacities like Jakarta, floods occur regularly (annually) due to poor water management combined with high rainfall. Environmental science has a very important role in efforts to convey knowledge to humans individually or to society in a wider scope regarding living things, nature and the surrounding environment, as well as the patterns of interaction that are formed between the two, the impacts caused by activities carried out by humans (Barszcz et al., 2022; Maurer et al., 2020; Sipahutar et al., 2019). Therefore, knowledge about pollution is very important in the process of forming an understanding of the environment, so that in the end this knowledge can be applied properly. This is an important value of the need for junior high school students to be equipped with knowledge about environmental disasters and mitigation (efforts to handle) environmental disasters.

The development of biology learning media, especially on the topic of environmental disasters, is an urgent matter to implement. Comics as a medium can be an alternative to convey various concepts of environmental disasters in Indonesia. The learning media in the 21st century has a role to improve 21st century skills, namely critical thinking, creative thinking, collaboration, and communication. These 21st century abilities need to be developed so that students can compete in a global world. Biology learning must facilitate students to be able to think critically using learning media (Bruehl et al., 2015; Hashim et al., 2019; Huang et al., 2022; Muhlisin et al., 2016; Orozco & Yangco, 2016; Saputri et al., 2019; Yacoubian, 2018).

Comics are simple, clear and easy to understand. This is possible because comics combine the power of images and writing which are arranged in a storyline so that information is more easily absorbed in biology learning. Comics have advantages such as provide positive experiences, increase motivation and participation in learning, improve social competence and cooperation, improve learning outcomes, improve the transfer of learning and support interaction, and accommodate the learning styles of students (Puspitorini et al., 2014; Xu & Ke, 2016; Yee et al., 2015). Based on the description above, it is necessary to carry out development research to accommodate these conditions by conducting this research.

Method

The method used in this study is research and development or product-oriented Research and Development (R&D) in the field of education. The

product development used in this study refers to the ADDIE development model (Branch, 2009). This model consists of five main phases or stages, namely Analysis, Design, Development, Implementation, and Evaluation. The product developed in this research is project-based learning-based environmental disaster and mitigation comics to increase students' knowledge. The targets in this study included teachers and students of class VII at MTs Ar-Ridho Sentul.

This research activity was carried out by starting with a needs analysis of the media to be developed. The media developed in this case is in the form of comics based on PjBL on the topic of environmental disasters. Needs analysis was carried out by interviewing students and teachers. The results of the interview became the basis for planning at the next stage.

The next stage is related to media planning to be developed. In this case the media design to be made is written in a storyboard and then explained in detail for each part. This part of media planning is important to determine the type of media to be developed.

The third stage is part of media development. In this case the media developed is in the form of comics with the theme of natural disasters. Comic media developed based on the plans that have been made. The results of the development were then validated by the media by experts.

The fourth stage is the implementation of the comic media that has been developed. Implementation in this case the comic media is used in class in biology learning. Then students will learn to use the media.

The fifth stage is evaluating the comic media that has been developed. Evaluation is done by giving pre-test and post-test. The results of the evaluation were then carried out by data analysis.

Result and Discussion

The product produced in this development research is a comic based on PjBL on environmental disaster mitigation and mitigation materials. The comics produced have three chapters, namely 1) Layers of the Earth comic, 2) Volcano and Earthquake comics, and 3) Environmental disaster Threat comics. The results of the validation of content, material, and media experts are as follows: Content validation is carried out to ensure consistency between learning objectives and the curriculum, material and indicators, the accuracy of the animations displayed in comics and the material taught is appropriate or not with the level of student development. The results of the validation are as follows: content expert.

Based on the results of validation by expert 1, it is known that the content aspect has valid eligibility

criteria because it has a score of 60% - 79%. The total obtained is 28 with a maximum score of 36, so that an overall percentage of 77.78% is obtained with quite valid criteria. Media validation on comics is carried out to determine the feasibility of systematics, the quality of the media meets the criteria, the selection of images that are displayed clearly and the size that matches the comic as well as the attractiveness and ease of using the comic, along with the results of validation by media experts.

Table 1. Content Expert Validation Results

Aspect	Result
Score	28.00
Maximum Score	36.00
Percentage	77.78%
Criteria	Quite Valid

Table 2. Media Expert Validation Result

Aspect	Validation Result Expert 1	Validation Result Expert 2
Score	48.00	46.00
Maximum Score	52.00	52.00
Percentage	93.30%	88.46%
Criteria	Valid	Valid

Based on the results of expert 1 validation, it was found that the media aspect has valid criteria because it has a score of 80% -100%. The overall score of media expert 1 is 48 with a maximum score of 52, so that a percentage of 93.30% is obtained with valid criteria, while for the number of media experts 2, an overall score of 46 is obtained with a maximum score of 52, so that a percentage of 88.46% is obtained with valid criteria . The total score of the two media experts reached 94 scores with a total percentage of 90.38% with valid criteria.

Validation of material or content from comics is carried out so that there is compatibility between the material contained and the competencies that must be achieved by students and does not cause misunderstanding of the material that has been included. The following are the results of validation by material experts.

Table 3. Material Expert Validation Result

Aspect	Result
Score	60.00
Maximum Score	68.00
Percentage	88.23%
Criteria	Valid

Based on the results of the material expert validation, a total score of 60 was obtained with a maximum score of 68, so that a percentage result of 88.23% was obtained with valid criteria. The appearance of the media that has been developed is as follows.



Figure 1. Display the contents of the comic media



Figure 2. The closing view of the comic

The effectiveness of PjBL-based comic learning media on environmental disaster mitigation and mitigation materials at MTs Ar-Ridho Sentul. Limited field trials were carried out using one class as the research subject, namely class VIII. The class consisted of 19 students and was given an experiment using comic learning media. Class VIII uses the One Group Pretest Posttest design with multiple choice instruments on environmental disasters and mitigation. The results of the field trials are presented in the following table.

Table 4. Pretest and Posttest Results on Natural Disasters and Mitigation Materials

Implementation Data	Pre-test	Post-test
Total of Students	19.00	19.00
Maximum Score	80.00	97.00
Minimum Score	50.00	74.00
Average Score	69.20	85.20
N-gain		Moderate

The results of the Pretest and Posttest of 19 students in the class experienced a significant increase in scores. This can be seen from the average pretest score of 69.2 and posttest of 85.2. Comic learning media has a good level of effectiveness, this is evidenced by the N-gain value of 0.52 which is included in the medium category. In addition, the results of distributing student response questionnaires show an average value of 80% which is included in the appropriate category to be used as learning media. Then it is known that the two assessment indicators have a fairly high percentage level, where the highest percentage is obtained on the assessment indicator of language and material clarity, which is equal to 80%, this is because the comics made have language and material that students can easily understand, then the knowledge assessment indicator environmental disasters and mitigation that is equal to 82%. This is explained because comics are made to increase students' knowledge of environmental disasters and mitigation.

Learning biology using innovative learning media such as comics will encourage the implementation of 21st century education more intensively. The ability of students to be able to think critically is needed in relation to environmental issues, especially related to disasters. Mitigation efforts need to be known by students so they can anticipate the various impacts that occur on the surrounding environment. Biology learning, in this case, requires innovative learning media so that students can contribute relevantly to 21st century competition (Cukurova & Bennett, 2018; Motallebzadeh et al., 2018; Rogayan Jr et al., 2021; Sadiqin et al., 2017; Wikanta & Susilo, 2022; Zulfiani et al., 2020). Comic media developed will indirectly improve students' ability to think critically and think creatively. This certainly has an impact on increasing students' ability to solve environmental problems experienced by students.

Conclusion

Based on the results of research and development of PjBL-based comic learning media on the Earth Layer and Mitigation material, it can be concluded that PjBL-based comics developed in schools as learning media to assist teachers in teaching and increase student knowledge. Comic learning media also get an

assessment from the results of validation by several experts. The results of the theoretical validity test based on aspects of material, media, and content, have a score of 90% with a valid category and are suitable for use in learning.

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Author Contributions

The first author has contributed in providing media design and ideas in media development. The second author carries out media development with implementation in the field. The third author has contributed in writing the article and updating the references used. The fourth author has contributed in revising articles and overseeing the scientific publication process.

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Conflicts of Interest

Authors declared no conflict interest in this research.

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