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Article

Analyzing Learners' Needs and Designing Digital Comic Media to Improve Student Learning Outcomes

Totok Bintoro
Faculty of Education, Universitas Negeri Jakarta
Email: tbintoro@unj.ac.id

Fahrurrozi
Faculty of Education, Universitas Negeri Jakarta

Ika Lestari
Faculty of Education, Universitas Negeri Jakarta

Indari Nur Aini
Faculty of Education, Universitas Negeri Jakarta

Abstract

Purpose: During this pandemic, teachers and students faced difficulty in adapting to changes in instructional learning while transiting from face-to-face to online learning. The purpose of this research was to develop digital comic media to improve student learning outcomes. **Research Design**: The research design in this study was built in two stages, namely the needs analysis stage and the design stage. This research was conducted at the public elementary school 04 Pagi Ciganjur, DKI Jakarta, involving 32 fourth-grade students. The study used a test instrument (pretest) to determine the students' prior knowledge. **Findings and implications**: At the needs analysis stage, it was found that students needed comics media to improve their learning outcomes, while at the design stage the researchers arranged stories according to the teaching material chosen for this experiment. Comic media can help students understand abstract concepts into concrete by creating their own learning experiences. **Future research avenue:** Further research can examine the effectiveness of the media on student learning outcomes based on gender.

Keywords

Learning outcomes, online learning, digital comics, elementary students.

Correspondence to Totok Bintoro, Faculty of Education, Universitas Negeri Jakarta, Email: tbintoro@unj.ac.id

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The COVID-19 pandemic has changed the world in various domains, one of which is that of education. Changes that occurred in the educational domain relate to learning strategies and instructional techniques (Aliyyah et al., 2020). Learning activities that were previously carried out face-to-face have now been replaced by online learning. Online learning was seen as a solution that can be used during this pandemic to keep teaching and learning activities running. This transformation in learning activities forced teachers and students to adapt to the changed conditions (Putri et al., 2020). Online learning has several advantages, namely students can learn to use technology to expand their knowledge which will have a good impact on their future (Süt & Öznaçar, 2021). However, online learning also has drawbacks, namely the effectiveness of online learning is not the same as face-to-face learning (Sahin & Shelley, 2020).

One of the important things that must be given utmost priority in this pandemic was student learning outcomes. Learning outcomes are descriptions of the abilities, skills, and knowledge achieved by students at the end of learning activities that can be used by teachers to assess what students gain during learning (Top Hat, 2020). Online learning is said to be successful if student learning outcomes are in accordance with the desired results (Panigrahi et al., 2018). In addition, teachers also need to know the factors that influence student learning outcomes, such as background, interests, learning attitudes, learning motivation, and students' learning styles (Helma & Murni, 2020). In addition, in order to achieve effective learning outcomes, teachers also need to know the characteristics of learning outcomes, namely student-oriented learning, what students should do, content that is appropriate to the cognitive level and in line with curriculum objectives, and the material being taught (Denise & Jane, 2021).

The current study focused on the development of comic media that is believed to be effective in enhancing the learning capabilities and play vital role in increasing the learning outcomes. The study aimed to examine the effectiveness and usefulness of the comic media in enhancing the learning performance. The study raised the questions related to the education domain during pandemic and examine the extent to which it suffered in terms of quality due to shifting to online platforms. This study was also concerned with the quality of education at schools in Indonesia, and raised a few questions: Did pandemic era negatively affect the education sector? Were the stakeholders in the education industry prepared for online learning before they adopted the online platforms for education purpose? Does Comic media have enough significance to prove as a much appropriate education method for online learning?

The objective of the current research therefore entailed the development of digital comic media to improve the learning outcome among students. This study aimed at determining the basic issues and problems in learning as it was observed by students. It also accepted the difficulties that had been faced in understanding the material during online learning. The study also aimed at addressing the issues like lack of experimentation and application in learning outcomes that had never been considered by prior research studies. This study was also based on the premise that effective media was required for students in accomplishment of effective learning.

Literature Review

Several research studies in the context of student learning outcomes have been carried out, such as on the use of animated video media and motion graphics media (Hapsari & Hanif, 2019); on the influence of good school culture on student learning outcomes (Amtu et al., 2020); on ways to improve student learning outcomes by using the flipped classroom instructional strategy considered as the best way to structure student learning experiences (Cheng et al., 2019) and on the influence of interactive media e-books (Hadaya & Hanif, 2019). These researches have taken place in several Asian countries like Turkey, Korea, China, Malaysia, and Indonesia with participants involving students from every level of education including elementary schools. Additionally, learning models such as Science Technology Engineering Math (STEM) have also made a good influence on thinking skills and student learning outcomes (Wahono et al., 2020).

A study was conducted on production of character-based comic media for its potential benefits in development of character education among fourth grade students (Rina et al., 2020). This research not only suggested various stages necessary for data collection and planning of research, but also drew outlines for product development, expert validation, expert-based revision, trials of products, product dissemination, product improvements and limited trials for final product in the field. The study depicted that character-based comic media had tendency to produce better learning and highlighted the quality aspects of the comic media. It also reported how comic media development can effectively enhance and add value to the learning process (Rina et al., 2020).

Another study found out how the COVID-19 compelled education to be conducted online as huge number of students were unaware and felt discomfort with the online learning process (Dwiasih & Agung, 2021). The study also reported the lack of instructional media application and implementation by the teachers, which negatively influenced the learning process in Indonesia. The study reported that students were not interested in material, therefore the instructional media could not create the interest in learning process. The study highlighted the need to conduct the study to describe the role of instructional media in learning process. It outlined the development process for finding the validation of e-comic based review of experts, individual try out, and small group try out. It also reported that teaching activities can be conducted under comic perspective as better outcomes have been observed through e-comic base education as compare to subject master, instructional design expert and media expert (Dwiasih & Agung, 2021).

Howe et al. (2019) stressed upon the needs to make efforts to improve student learning outcomes through the interaction between teachers and students. It was consistent with another study that examined the effect of using real media on learning outcomes (Lalian et al., 2019). Another Research conducted by Lai (2018) in Taipei revealed how environmental education activities could help students get hands-on learning experiences. The integration approach of science and language also had significant results in influencing student learning outcomes (Fazio & Gallagher, 2019). In addition, other studies also recommended the use of interactive CD media as an effort to improve student learning outcomes (Qistina et al., 2019). Based on the research done, it can be concluded that student learning outcomes can be improved through many ways, starting from the use of media, learning models, teacher and student interactions, and other educational activities.

Another research conducted by PISA in 2018 showed the level of reading, mathematics, and science scores in Indonesia. These scores were far below the average of the Organization for Economic Co-Operation and Development (OECD, 2019). Figure 1 presents these results.

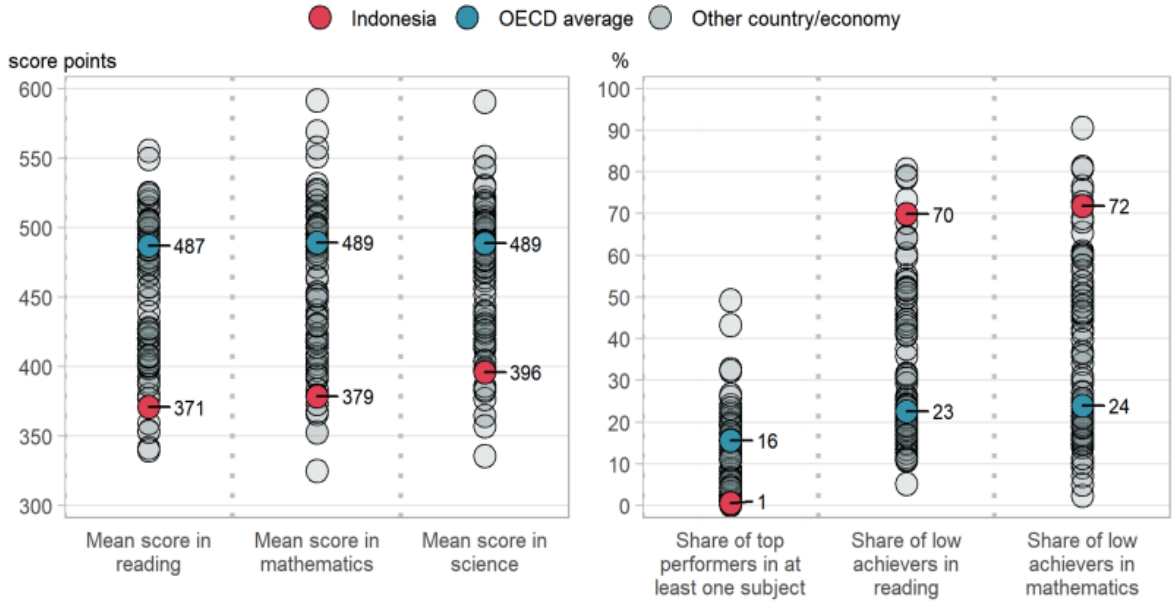

Figure 1. *Result of PISA 2019.*

Figure 1 shows that science scores are better than reading and math scores, but science scores in Indonesia could only reach the score of 396, which is below the OECD average of 489.The scientific value that students received was based on correct explanations for familiar scientific phenomena and could use that knowledge to identify simple cases. This research is in line with the results of a preliminary study which concluded that student learning outcomes in science subjects are still relatively low (Rina et al., 2020). This study had collected data from 32 fourth grade elementary school students at the public elementary school 04 Pagi Ciganjur, DKI Jakarta. Out of the total sample, 14 students had not yet achieved complete learning (getting a score of <75). The scores obtained by students ranged from 40-100 with an average value of 68.13, so it was still necessary to improve the material presented by the teacher in order to improve learning outcomes.

Various ways can be done to improve science learning outcomes for elementary school students, one of which is through the media. Comics are media that contain pictures and short stories. Pictures in comics can convey abstract concepts into concrete ones (Akcanca, 2020). Comics can help students create learning experiences, if they are connected to the context of students' everyday lives (Affeldt et al., 2018). Thus, the current study developed a digital comic media as an effort to improve the learning outcomes of fourth grade elementary school students in science subjects.

Method

- *Research design*

A design-based research method was used to carry out this study. The ADDIE model was used to design the digital comic book. The ADDIE development model consists of five stages, namely Analysis, Design, Develop, Implementation, and Evaluate. However, for this study, we used only the first two stages, namely the Analysis stage and the Design stage.

- *Sampling and research procedure*

The sample of the study comprised of 5 class teachers and 24 fourth grade students aged 10-11 years at the public elementary school of 04 Pagi Ciganjur, DKI Jakarta. The purposive sampling method was used to identify the sample and questionnaires were distributed with the help of Google Forms

- *Instruments*

The students needed a media that could help run active and effective learning activities. hence, a needs analysis questionnaire was distributed to the students to find about their required needs. The teachers acted as informants in an in depth interview. In the first stage of Analysis, the researcher determined the basic problems in learning. This study involved both teachers and students. This stage involved a test of students' science learning outcomes before using digital comic media. In the second stage of Design, media was designed that functions to improve student learning outcomes in science lessons, in the form of digital comics. The flowchart process was adopted for designing the media and according to student needs.

- *Data analysis*

The data was analyzed using the eligibility criteria of the media selected followed by testing each criterion for its validity and relationship on a flow chart. Such problems felt by students like difficulties in understanding the material due to the lack of application of experimental activities in science lessons were retrieved during the analysis. The media eligibility criteria can be seen in table 1.

Table 1. *Media eligibility criteria*

No.	Score in percent (%)	Eligibility category
1.	< 21%	Very unworthy
2.	21%-40%	Not feasible
3.	41%-60%	Decent sufficient
4.	61%-80%	Worthy
5.	81%-100%	Very worth it

Results

- *Stage 1: Student Needs Analysis*

This digital comic was designed based on the results of the analysis of student needs. Analysis of student needs was conducted by researchers during the learning process. The learning media that teachers and students used were less varied, which were mainly learning videos. As many as 95.5% of students stated that with experiments, students understand science material more easily. 63.6% of students stated that experimental activities in science learning were only carried out 1-2 times. As many as 86.4% of the total students stated that they needed digital media to understand the material.

The results of student learning tests in science subjects before using the media showed that they were still below the average (<75), which only reached a score of 70. The range of scores obtained by all 24 students ranged from 30-100. Only 11 students exceeded the average score. This can be seen in Table 2.

Table 2. *Science Learning Outcomes Pretest*

Respondent	Score Range	Mean	Mode	Median	Standard Deviation
24 students	30-100	70.00	60.00	70.00	20.48

Table 2 shows that the average pre-test score of the experimental group is 70. This shows that the average experimental class students do not meet the minimum score of the standard passing criteria. The mode, median and standard deviation are 60.00, 70.00, and 20.48, respectively. Based on the results of the pre-test, it was necessary to do treatment to improve student learning outcomes so that they can exceed the specified graduation standard.

In the pretest, only 8 students (30%) answered correctly. Thus, the researcher concludes that students' understanding of the sub-material of light refraction still needed to be improved. Table 3 illustrates the difficulty index of the items in the pretest.

Table 3. *Item Difficulty Index of Science Learning Test Results*

Question Item Number	Difficulty Index	Category
1	0.78	Easy
2	0.66	Medium
3	0.75	Easy
4	0.63	Medium
5	0.81	Easy
6	0.88	Easy
7	0.75	Easy
8	0.84	Easy
9	0.31	Medium
10	0.59	Medium

Based on the data in table 3, it is found that the index of the level of difficulty of the items is in the easy and medium categories. Thus, it can be said that the category of items that have been compiled with levels of difficulty items is in the range of 0.71 to 1.0, namely in the easy category, while the range of 0.31 to 0.70 is in the medium difficulty level.

- *Stage 2: Comic Design Results*

The digital comic media developed in this research is known as COMINS (Comic in Science). COMINS was designed in three parts, namely introduction, body, and closing. The COMINS design can be seen in a flow chart presented in Figure 2.

The introductory section contained a cover, instructions for use, and character introduction. The second part contained materials, experiments, and exercises. The closing section contained a glossary. The schematic parts of the COMINS design can be seen in Figure 3, Figure 4, Figure 5. These figures show the cover of COMINS that play important role in attracting the respondents, the figure also shows the content and back cover, that shows the potential of COMINS to increase the learning.

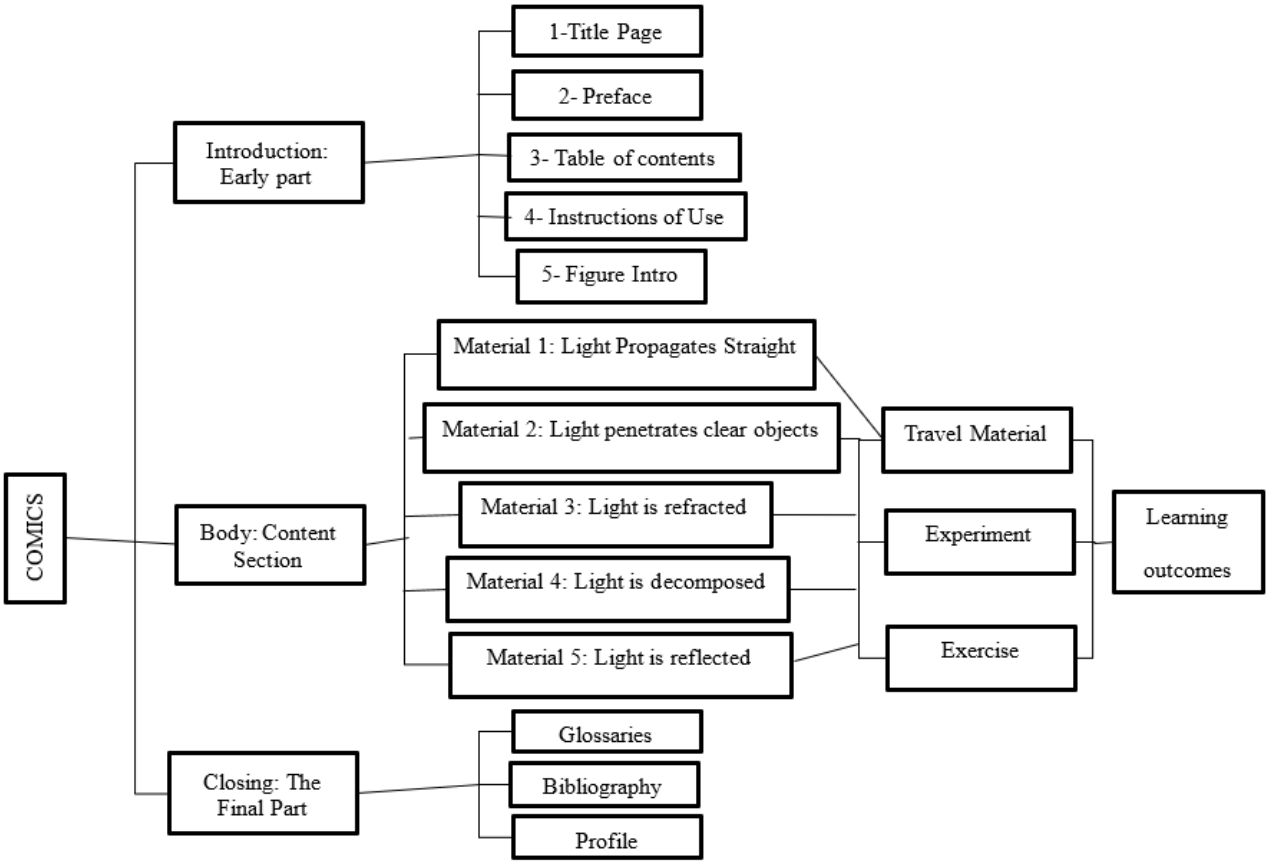

Figure 2. *Flow chart of COMINS design*

Figure 3. *The cover of "COMINS".*

Figure 4. *Content of "COMINS".*

Figure 5. *Back cover of "COMINS".*

- *Comic Media Validation Results*

The feasibility test for the "COMINS" comic media on the light properties sub-material carried out in this study consisted of media expert validation, linguistic validation, and material expert validation. The validation results of the media expert "COMINS" comic can be seen in Table 4, the material expert "COMINS" comic validation results can be seen in table 5, and the validation results of the linguist "COMINS" comic can be seen in Table 6, as well as the average score of the three validation results in Table 7.

Table 4. *The results of the validation of the comic "COMINS" media experts*

Rated aspect	Appropriateness (%)
"COMINS" comic cover appearance	80
Readability of writing with appropriate font type and size	80
simple background	80
Image presentation attracts attention	80
Images and illustrations used are in accordance with the material	80
Image size	80
Proportional paper size	80
Choose the right color	80
Average Eligibility of "COMINS" Comic media display format	80

Table 5. *The results of the validation of the material expert "COMINS" comics*

Rated aspect	Appropriateness (%)
Themes according to students' cognitive development	80
The theme of the story in comics is in accordance with science learning	80
The accuracy of the theme with the combined SK and KD	80
The accuracy of the translation of KD to indicators	60
Clarity of the formulation of learning objectives	60
Water pollution material does not cause many interpretations, according to the truth of facts, principles and concepts	80
Presentation of easy-to-digest concepts	80
Stimulate students to read	80
Completeness of information with a bibliography and completeness of questions	60
The storyline of presenting the material properties of light	80
The average feasibility of the comic material "COMINS"	**74**

Table 6. *The results of the validation of the comic "COMINS" linguist*

Rated aspect	Appropriateness (%)
Language in accordance with the development of students by using simple and commonly used language, short and clear	80
Use language with proper sentence structure	80
The terms and vocabulary used match the concept of the properties of light.	80
Average Eligibility for Presentation of Comic Language "COMINS"	**80**

Table 7. *The average validation results for "COMINS" comics*

Validator	Average validation results in percent (%)
Media expert	80
Material expert	74
Linguist	80
Average of average score	**78**

The results of the feasibility test from media experts in Table 4 states that comic media received an average score of 80% in the aspect of testing the display format of the comic media "COMINS". This shows that the developed media had been assessed as feasible. However, the results of the feasibility test from the comic media material expert "COMINS" in Table 5 reached the appropriate criteria by getting an average score of 74%. In addition, the aspect of using the language of the comic "COMINS" media based on the results of the feasibility test from linguists also got an average score of 80% as shown in Table 6. It can be concluded from the results of the feasibility test from the three experts that the comic media "COMINS" received a total average score of 78%, suggesting that this media obtained the media eligibility criteria in the appropriate category.

Discussion

The low learning outcomes of students during online learning can be seen from the results of the pretest of students in the needs analysis stage which shows that the average score of students is still below the standard of graduation criteria. One of the factors that influence it, namely online learning, makes it difficult for students to understand the material and makes it difficult for teachers to convey the material. In addition, the results of the needs analysis also show that students and teachers needed a digital-based media to help the learning process run to improve student learning outcomes. Therefore, researchers innovated digital comics that can make it easier for students to understand the material independently, and they are able to improve their learning outcomes in online learning (Akcanca, 2020). However, other studies have argued that the use of comics makes students learn without any challenges, so students are less trained to think critically (Smith, 2021), which the results of this study contradict.

Comic design must be in accordance with the needs of students and also in line with development goals. The results of the needs analysis proved that students needed media other than learning videos; media that contained experimental activities which can help students understand teaching material can more easily. To meet this need, digital comic media was designed which contained material accompanied by experimental activities as well as exercises that tested students' understanding after reading the material and conducting experiments. This finding is consistent with Azamain et al. (2020) who also contended that students better understand the material with a design like this, since they are able to create their own learning experiences through learning activities. By creating their own learning experiences, students' understanding is also deeper and lasts longer.

The study also premised that digital comic media can be used as an alternative media that can be used by students and teachers during online learning. This media is the right media as it promises to have a good impact on students' learning outcomes (İlhan et al., 2021). The findings revealed that comics have many advantages as learning media, including making students motivated to learn, creating students' interest in reading, making it easier for students to understand material that is difficult to understand, making abstract concepts concrete, consisting of a combination of verbal and visual media, as well as composition. The storyline that is structured and presented in pictures makes the reader interested in reading it to the end. This is supported by research which states that students can learn more deeply through material presented in words and pictures, compared to material presented only in words (Mayer, 2003).

The media development carried out by in this study during the second stage of Design resulted in a digital comic media design which we named as "COMINS". The name COMINS itself has the meaning of comic in science, which is an educational media presented in the form of comics to improve student learning outcomes in science subjects. Based on the media validity test by three experts from media, material, and linguistics, the comic media "COMINS" was classified as decent average score for its criteria. The validity tests focused on all the aspects of the suitability of the story theme, ranging from students' cognitive development to the theme of the story in comics in accordance with natural science learning, to the accuracy of the theme with the terms and conditions and basic competencies that were combined, to the accuracy of the translation of basic competencies to indicators, to the clarity of the description of basic competencies to indicator, and to the clarity of the formulation of the average learning objectives of these aspects. All these aspects were found quite feasible which showed that the material in the comic "COMINS" was clear and presented in accordance with the cognitive development of students. Moreover, it was also evident that it was not difficult for students to understand the material. This is in line with other research studies that state that comics media have a positive influence on students, and which can help them understand the material through simplification of concepts, so as to improve students' understanding (Khiyarusoleh et al., 2018; Roswati et al., 2019). However, these results disagree with the research of Lin and Lin (2016), which stated that not all students can use comic books, especially those who have low levels of knowledge.

The material designed was adapted to the characteristics of elementary school students where in the delivery of "COMINS" media was explained through story texts and colorful pictures. This made it easier for students to understand the meaning. The presentation of easy-to-digest concepts made students understand the material clearly. By presenting a regular storyline, it stimulated students to read. The storyline of presenting the material properties of light using digital comics made students understand the material easily. Hence, it was concluded that the way the material is delivered in this comic improves student learning outcomes (Toh et al., 2017).

The appearance aspect of the "COMINS" comic cover consisted of features like legibility of writing, appropriate font type and size, simple background, presentation of attractive images, etc. The images and illustrations were used in accordance with the material, image size, proportional to the size of the paper and with appropriate color selection. The average criteria for the aspects were found feasible. The readability aspect of the writing with the type and size of the font was appropriate, but one of the suggestions from the validator was to modify the type and size of fonts to be same for each word balloon, which was accepted. The background was kept simple aiming to focus students on the storyline picture box, so it did not interfere with students' views while reading. Aspects of presenting images attract attention, images added with color attracted students' attention to see and understand the meaning of the image.

In our comic design, there were also animated images of humans, where one teacher and three students were having a dialogue in a classroom. These images were presented with coloring on pictures that attracted

learners' attention. This is in accordance with the characteristics of comics media, which requires that media should present material in the form of simple text and images so that it can attract students' attention in learning and will have an impact on students' learning outcomes (Hosler & Boomer, 2011). However, this finding contradicts with research of Özdemir (2017) which stated that comics media should be designed by containing more humorous stories and according to everyday life situations.

The images and illustrations used in our design were in accordance with the material, suggesting that the content of the comic "COMINS" was in accordance with the learning materials of students at school. The size of the image in the comic "COMINS" media was quite decent, because the size of the image in the comic was not too big and not too small. In one page only, it contained three to six images. The paper size was in accordance with the size of a comic book in general, which was A5. In addition, the color selection was also appropriate, suggesting that the colors in the comics were in accordance with the characteristics of elementary school students who liked colors that were not too soft and not too contrasting. This is in line with the recommendations that the use of color must be considered because color affects the effectiveness of learning and student interest (Simpson, 2018). For example, the use of monotonous colors will create a passive atmosphere, while the use of bright colors will create an energetic atmosphere. However, the use of bright colors must be combined with softer colors in order to make the atmosphere comfortable.

The feature of language in the comic "COMINS" media consisted of 3 aspects, namely the language aspect which was a simple and commonly used language, brief, and clear; the aspect of using language with the right sentence structure; and the aspect of the terms and vocabulary which should be compatible with the topic under study. The average criteria of the three aspects of language presentation in the comic "COMINS" were found quite decent. In the comic "COMINS" the language used was students' everyday language, which was good and simple Indonesian. The use of simple language made it easier for students to read and understand the material. The sentence structure used in the comic "COMINS" also followed the right sentence structure. Similarly, words and vocabulary items were consistent with the science topic under study. This was proven by the fact that none of the terms deviated from the topic. There were a few foreign terms which were explained so that students can understand them. This is in line with the research which also recommended that the main function of the media was to act as a tool to convey messages from the source to the audience, because the use of language in the media must be very concerned (Marpanaji et al., 2018).

The "COMINS" comic media was tested for validity and feasibility which showed that it was suitable for use for the fourth grade elementary school students. This validity showed that the comic "COMINS" media had many advantages, including having images that matched with the characteristics of students; it was equipped with attractive colors; it used simple language so that it could make it easier for students to understand the material. In addition, the material was presented with an orderly and clear storyline, and in accordance with the cognitive development of students. This is in line with research showing that comics made learning more meaningful if they are designed for learning and if they consider students' cognitive development (Jee & Anggoro, 2012).

Conclusion

COMINS is a digital comic media that was designed to help students understand the learning material more easily and to enhance their learning outcomes. The characteristics of COMINS were well packaged in the form of a true story of students at school. In developing this digital comic, researchers focused on the content or material, experimental activities, and students' learning outcomes. COMINS has several advantages, namely (1) helping students to form understanding using student learning experiences, (2) turning abstract concepts into concrete (3) can be used anytime and anywhere just by downloading it either on a cellphone or computer.

Learning media is a tool that can convey information from the teacher to students. Based on this research the study recommends that developers should pay attention to such characteristics of media like students' needs, instructional objectives, and students' cognitive development. In addition, the media developed must also be easy to use, the material presented should be easy to understand, it should attract attention and should be flexible. Further, the learners should be able to use it for a long time and would not cost a lot of money. It is hoped that further research can examine the use of digital comics in learning outcomes for higher grades and whether they influenced different genders.

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