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DEVELOPMENT OF DIGITAL COMIC AS A BIOLOGY LEARNING MEDIA

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ABSTRACT

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This study aims to develop and test the feasibility of digital comic-based learning media and to examine its effect on student's learning outcome in cell material. Learning media was developed according to the 4D development model of Thiagarajan which consisted of four stages, namely define, design, develop and disseminate. Media was validated by content expert, media expert, and learning expert. The suggestion from biology teacher and students of class XI MIA 2 SMA Negeri 2 Percut Sei Tuan were asked. The data of study were obtained through validation instruments, questionnaires, and cognitive test. Data were analyzed qualitatively and quantitatively. The result of the study showed that the developed comic media was considered very feasible by material expert (94,38%), media expert (89,34%), and learning expert (96,00%). Comic was considered very feasible too both by biology teachers (93.22%) and by students (92.38%). The results of the paired sample t-test on the pre-test and post-test score of $0.00 > 0.05$ indicate that the post-test score is bigger than the pre-test score. The data showed that the result of cognitive test had increased significantly after using the developed digital comic media.

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INTRODUCTION

Technology and information are developing very rapidly. Gadgets and the internet have become a primary need in life and internet users have increased from year to year. It was reported that in 2016 internet users in Indonesia amounted to 132.7 million (51.8% of the total population of 256.2 million). This number increased to 143.26 million (or 54.68% of the total population of 262 million) in 2017, to 171.17 million (64.8% of the total population of 264.16 million) in 2018, and rose again to 196.71 million people (73.7% of the total population of 266.91 million) in 2020 (APJII, 2016; 2017; 2018; 2020). The report also reveals that the majority of internet users are teenagers aged 15-19 years (high school age and equivalent) who have their own interest in the internet regardless of what sites they access.

The presence of the internet should be used to improve the quality of learning. [Haka & Suhandia \(2018\)](#) state that technological developments in the field of education should be able to create a comfortable atmosphere in the learning process. However, [Irwandi & Juriah \(2016\)](#) reported that it turns out that educators have not optimally utilized the internet, especially in terms of using learning media. Educators are only used to using offline learning media, such as videos and PowerPoint.

On the other hand, students need an alternative and more varied learning media so that the learning process does not become monotonous ([Chalim & Anwas, 2018](#)). In their daily life, millennial children's activities such as playing, communicating, socializing, and channeling hobbies and other aspects, never escape internet technology. It is not surprising that the majority of students prefer a learning atmosphere that follows the progress of technology and information development (Widana et al., 2018; Brata et al, 2021).

This research is aimed at developing internet-assisted biology learning media in the form of digital comics as an effort to utilize the internet in learning activities. The internet-assisted digital comic learning media was chosen because it is very attractive to students because of its language and presentation that is not rigid. In addition, it is reported that digital comics can increase attention and help students understand the subject matter ([Irfana et al., 2017](#); [Aeni & Yusupa, 2018](#)) so they are very effective if used in independent teaching of students with visual and auditory learning types ([Setyorini & Hartono, 2017](#)).

Digital comic-based learning media has several advantages compared to printed comics, including digital comics that are more durable, more environmentally friendly, more practical,

easier to distribute, and more efficient or economical. Cell material was chosen to be the content of the media because students had difficulty learning the material due to the complex nature of the material. Cells are too small to make them difficult to see with the naked eye. [Ulfa's study \(2021\)](#) showed that students had learning difficulties in cell material with a very high category for each indicator, especially the indicator of knowing cell structure (80%), knowing the function of cell parts (84%), knowing the similarities of plant cells and cells. animals (90%), know the difference between plant cells and animal cells (81%) and analyze the passive transport of osmosis (90%). [Ramadanti \(2022\)](#) also reports that cells are one of the materials considered difficult by students based on teacher observations and students' daily test results.

An initial study of 30 students of SMA Negeri 2 Percut Sei Tuan who were asked for their opinion revealed that 73.3% stated that cell material was difficult to learn, 13.3% said it was very difficult and each about 6.7% said it was easy and very easy to learn. . This assumption also underlies the level of interest of students in cell material, from the questionnaire data it is also known that about 70% of students do not like cell material, 20% do not like cell material and only about 10% like cell material.

Cell material is studied in class XI in odd semesters. Learning difficulties in cell material will trigger learning difficulties in the next material. Because the discussion of the next material is the continuity of cell material. Based on the background of the problem above, this study aims to produce a digital comic-based biology learning media that is able to attract the attention of students to like cell material, determine the feasibility level of digital comic media based on the assessment of material experts, media experts and learning experts, find out how to respond teachers and students as media users and know the effect of using comics media on student learning outcomes on cell material.

RESEARCH METHOD

The study was carried out at SMA Negeri 2 Percut Sei Tuan, Jalan Pendidikan Pasar XI Bandar Klippa Village Percut Sei Tuan Deli Serdang, North Sumatra, from July to September 2021. The initial study was conducted through interviews with one of the teachers in the field of biology studies showed that students' interest in learning in biology learning is still low. It was also revealed that the teaching materials used were minimal with images or visualization tools, and the use of learning media was not optimal. As a result, learning biology seems

boring. This leads to low student learning outcomes in the field of biology studies.

The development of digital comic media for cell biology learning in class XI SMA was carried out following the 4D model from Thiagarajan. This model consists of 4 main stages, namely define, design, develop and disseminate. At the define stage, it is carried out through observation, interviews with teaching staff and distributing student needs analysis questionnaires, aimed at defining the background for developing comics media, student needs, assignments, concepts and analysis of learning objectives.

At the design stage, a test instrument is prepared that will be used to measure the effectiveness of the media on learning outcomes, media selection for comic development, format selection, comic character or character determination, place setting, paper size determination and font selection.

The develop stage is carried out to develop the design into a digital-based comic (first draft) and then validated by validators of material experts, media experts and learning experts. Validation is carried out based on a validation sheet in the form of a rating scale (Likert scale) which also contains a column for criticism and suggestions for comic improvement. After improvements based on input from the validator, the draft media was then revised before being distributed to educators (biology teachers) and then to students to find out their responses as media users. After the validation stage, the comics were then tested in a small group (12 students) of the selected class XI MIA, which consisted of the same number of representatives of students in the smart, medium and less intelligent categories.

The dissemination stage is carried out by distributing the final product, namely digital comic media, to all students of class XI MIA at the research school for use. Before using the media, students were previously given a pre-test and at the end of

the use, they were given a post-test to see the effect of using digital comics on learning outcomes.

The research data were analyzed qualitatively (criticisms, and suggestions from validators, teachers, and students) and quantitatively (questionnaire data or learning outcomes test data). The effect of media on learning outcomes was analyzed by comparing the pretest and posttest through paired sample t-test (t-test; $p < 0.05$).

RESULTS AND DISCUSSION

The final product of the development, namely a digital comic entitled *Sel dan Kesatuannya*, consists of 28 pages including the cover. Comic media is designed and developed through the Canva Premium app. Canva is a handy comic maker software. The use of this application is very easy, every element needed is already available so users can simply drag and drop, then users can design their comics according to their creativity without having to draw again manually. Comic products are in the form of comic strips with a paper size of 25 cm x 20 cm, written in moontime, aliengo, glacial indifferent, lazydog, more sugar, and dekho fonts with font sizes from 8 pt – 100 pt. Comics are loaded in PDF format and then distributed to students via WhatsApp class groups. The cover (Picture 1) displays animal cells and plant cells as well as other illustrative images, the symbol of FMIPA UNIMED, and the name of authors and supervisors, and validators. Comics are divided into 3 main parts, namely introduction, content, and closing.

According to learning material experts, the digital comics developed are very feasible (Table 1). Table 1 shows that comics are very feasible, both in terms of content (score 88.75%) and in terms of language (score 100%); the average score is 94.38%. Thus, from the aspect of content/material and linguistic aspects, comics are feasible to use.



Figure 1. Comic Cover Display Eligibility of Digital Comics in terms of Content/Material

Table 1. Comic Eligibility According to Material Expert

No	Aspect	%	Kriteria
1.	Contents	88,75	Very good
	The suitability of the material with core competencies, basic competencies and learning objectives		
	Clarity of learning materials		
	The suitability of biological comics with learning materials		
	The suitability of the story in the media with the learning material		
2.	language	100	Very good
	Language communicative		
	Accuracy of use of terms		
	Appropriateness of the language used		
Average		94,38	Very eligible

The Eligibility of Digital Comics in Visual/Graphic Perspective

Table 2 presents the feasibility data for digital comics in terms of visuals and graphics. Both the visual/graphic aspect (score of 90.67%) and the aspect of the integration of presentation (score of

88%) of comics reached very decent criteria. The average score for both aspects is 89.34%, still reaching the very feasible criteria. Thus, the visual aspect of graphics and the aspect of the integration of comic presentation meet the requirements for the eligibility of comic media.

Table 2. Eligibility of Comics According to Media Experts

NNo Aspect	%	Criteria
11 Visual/Graphic aspect Size accuracy Setting accuracy Image attraction Color accuracy Simplicity of comic media	90,67	Very good
22 Aspects of the Integration of Comic Presentation Integration of visual aspects Image/illustration suitability Clarity of storyline Image quality	88	Very good
Average	89,34	Very eligible

Feasibility of Digital Comics in terms of Learning Design

The feasibility of comics in terms of instructional design is shown in Table 3. Table 3

shows that from the aspect of learning comics achieved a score of 96% (very feasible category), meaning that this media fully meets the requirements in terms of learning design.

Table 3. Comic Eligibility According to Learning Experts

NNo Aspect	%	Criteria
11 Learning Design The relevance of learning materials in comics media with learning objectives, core competencies and basic competencies Suitability of media shape with cell characteristics Giving motivation Creative and innovative in learning media The suitability of the media with the characteristics of high school students Ease of using media	96	Very eligible

Eligibility of Digital Comics According to Teacher's Opinion

The feasibility of comics according to the teacher's opinion can be shown in Table 4. The

teacher believes that the comic media developed is very feasible, both in terms of content (score 91,43) and in terms of learning design (score 95%), with an average score of 93,22%.

Table 4. Eligibility of Comics According to Teacher's Opinion

No. Aspect	%	Criteria
1. Contents The suitability of the material with core competencies, basic competencies and learning objectives Clarity of learning materials The suitability of biological comics with learning materials The suitability of the story in the media with the learning material The attraction of comics as a learning medium	91,43	Very good
2. Learning Design The relevance of learning materials in comics media with learning objectives, core competencies and basic competencies Suitability of media shape with cell characteristics Giving motivation Creative and innovative in learning media The suitability of the media with the characteristics of high school students Ease of using media	95	Very good

Average

93,22

Very eligible

Student Opinion

Table 5 shows the opinions of students on the developed digital comic media obtained after small group trials of 12 students of class XI MIA 2. Students think that digital media development products are very feasible, both from the aspect of media usability (score 933, 33%) as well as from the aspect of media quality (score 91.43%).

Table 5. Comic Media Development Test Results

NNo.	Aspect	%	Criteria
11	Daya Guna Media	93,33%	Very eligible
22	Kualitas Media	91,43%	Very eligible
Rata-rata		92,38%	Very eligible

The Effect of Digital Comics on Learning Outcomes

The influence of digital comic media on student learning outcomes was analyzed by comparing the pretest and posttest scores. It was found that the average value (\pm SD) of students' learning outcomes before using digital comic media (pretest) was 61.64 (\pm 13.97) which increased rapidly to 80.10 (\pm 7.76) after using the media (\pm 7.76). posttest). The use of media can increase the average score of students by 18.14 (\pm 8.69) or 29.95% of the pretest score (Figure 2).

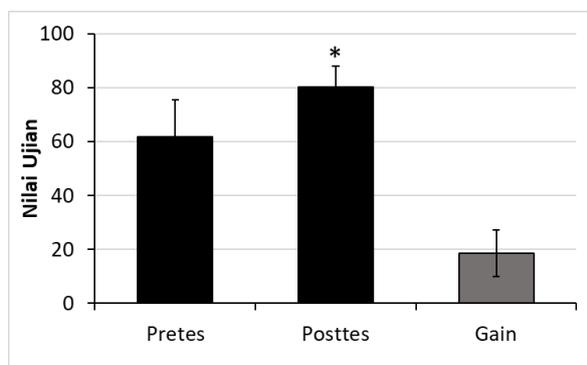


Figure 2. Average (\pm SD) student learning outcomes before (Pretest) and after (Posttest) the use of digital comic media in learning. The use of media increases the student's score (Gain) by 18.14 or 29.95% of the pretest score. The asterisk indicates that the posttest score is significantly different from the pretest score (paired sample t-test $p < 0.05$).

The development of digital comic media is intended to overcome the limited resources and or learning media on cell material at the high school education unit level. Comic media in digital form was deliberately chosen because this form is very

liked by students at the high school level so it can increase reading interest and will further improve their learning outcomes. The presentation of comics that contain strong visual elements and stories will encourage readers to continue reading them (Daryanto, 2017) so that students do not need to be persuaded to read because they will be interested in seeing the images presented in comics (Sudjana, 2011). In addition, according to Danaswari et al (2013), teaching materials in the form of comics media can improve students' visual intelligence because through comics students can translate the visual designs they see into their imagination and understanding which in turn can improve their learning outcomes.

To produce a decent product, media (digital comics) has been developed through special stages and the process is validated by validators who have the competence to assess the developed media products (Sugiyono, 2016). Aspects that are validated include material aspects, learning aspects, and visual/graphical aspects.

Validation of the material aspect is aimed at reviewing and assessing the feasibility aspects of the content/material and language of comic media. Material expert validators suggest improvements related to the breadth of the material more aligned with KI, KD, and indicators, use of simple language, reduction of images, and use of contextual examples. After being corrected, the material expert's assessment was 94.38%, it was included in the very feasible criteria. Teaching material can be said to be feasible if it has met the accuracy of content, accuracy of coverage, digestibility, use of language, illustrations, packaging, and completeness of teaching materials (Sadjati, 2012). The teaching materials, in this case, the developed comics media, have been validated by material experts and have obtained very appropriate criteria in presenting content and language, meaning that comics media are suitable for use as teaching materials in class XI.

Validation by media experts is needed to assess the feasibility of comic design from the visual aspect and the integration of its presentation. Media expert validators provide input, among others, so that the cover display can represent the contents of the comic and adjust the dialogue between characters so that the dialogue is more structured. The results of the media expert's assessment of media products that have been revised are included in the very feasible criteria with a score of 89.34%. Thus, the visual aspects and the integration of comic presentations are appropriate as learning media. This criterion is in

accordance with the opinion of [Sudjana \(2009\)](#) which states that students will understand more easily if the learning media is presented with clear images and colors so that learning objectives can be achieved.

Validation by learning experts is needed to determine the feasibility of comic media in terms of learning design. The feasibility of comics in terms of learning design is included in the very feasible criteria with a score of 96% after all inputs given by learning experts are adopted in improving comic products. [Sadjati \(2012\)](#) revealed that students can learn more easily if the forms of learning activities are more diverse, so that learning becomes

interesting, not boring or boring. Learning using digital comics is a new variation in learning that can stimulate students to like learning biology.

The teacher's responses to comics, among others, need to improve the color scheme of the comics, the size of the letters on each speech bubble and the text needs to be enlarged so that it is easy to read. However, this input has been intrinsically accommodated in digital comic products in PDF which can be zoomed out or zoomed in so that the font and image sizes can be enlarged or reduced according to the needs of the reader.

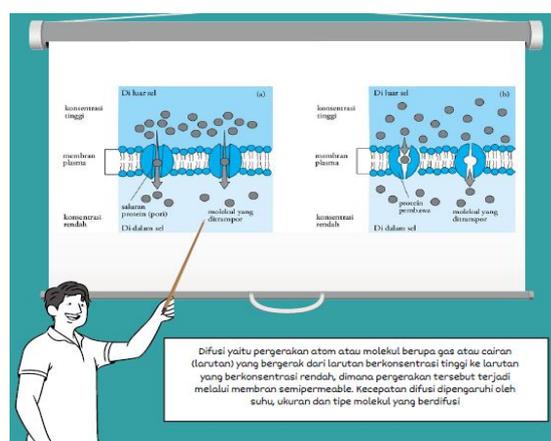


Figure 3. Examples of Comic Drawings before going through the validation and revision stages

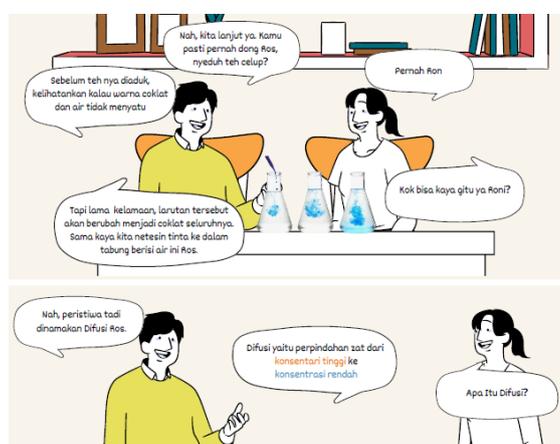


Figure 4. Examples of Comic Drawings after going through the validation and revision stages

Product trials on students were carried out through small group trials. The test was carried out on 12 students of class XI MIA 2 from 3 different groups based on their cognitive abilities, namely students who were smart, moderate and less intelligent ([Sadiman et al, 2014](#)). According to [Sadiman et al \(2014\)](#), the selection of small group trial samples is between 10-20 students in order to describe the target population. The results of the small group test obtained that the feasibility value of comic media was 92.38% with the meaning that

comic media entered the very feasible criteria as a learning medium for students in material about cells.

The digital comic products produced fall into the very feasible criteria with the details of the comic feasibility assessment as follows; the results of the material expert assessment are 94.38%, the media expert assessment is 89.34%, the learning expert assessment is 96%, the assessment based on the teacher's response is 93.22% and the results of the development trial for students in class XI IPA 2

are 92,38%. The results of this study are in accordance with the research of [Haka & Suhandu \(2018\)](#) where the results of media development fall into the criteria of being very suitable for use as learning media. The advantages of the developed product are that the product contains cell material that is presented systematically, contains interesting pictures and illustrations and has gone through a validation process, which can be read anywhere and anytime. Comics are practical because they can manage students' study time more efficiently ([Djamarah & Zain, 2010](#)). This happens because students can access comic media anywhere and anytime through their gadgets.

To find out whether the use of comics media has an effect on student learning outcomes, the pre-test and post-test scores were compared to the paired sample t-test. Based on the hypothesis test, it is known that there is a difference in the average pre-test and post-test of students which shows that the use of digital comic learning media has a positive effect on improving student learning outcomes on cell subjects. The average value of the pre-test was 61.64 with the number of students who reached the KKM (score 75) only 8 people (or 22% of all students). After being given using digital comics, the average final score (post-test) of students increased to 80.10 with the number of students who achieved the KKM score as many as 32 people (or 82% of all students). There was an increase in the average value of student learning outcomes by 18.46 (29.95%) after using digital comics. That is, digital comic media can improve students' understanding of cell material.

The same result has been reported by [Wijaya et al \(2020\)](#), there is a significant difference in the learning outcomes between students who use comic media and those who do not use comic media. The use of digital comic media is considered more able to attract the attention of students to understand the material. [Slameto \(2010\)](#) also revealed that students who have an interest in certain subjects tend to pay more attention to these subjects. Comics can provide image stimulation that can improve student learning outcomes, especially in terms of remembering and connecting concepts and facts ([Arsyad, 2017](#)). [Widana et al \(2018\)](#) also stated that the use of comic media was able to improve student's critical thinking skills. The results of a study by [Setyorini & Hartono \(2017\)](#) also reveal that digital comics are effective for teaching monologues to students with visual types. In addition, the results of the study also show that the use of digital comics is more effective in teaching students with visual and auditory types compared to printed comics. Based on the results of this study and other similar

studies, it is known that the learning media favored by students, in this case, is digital comic media can provide positive benefits for students, especially in terms of increasing interest in reading and also student learning outcomes.

CONCLUSION

There is a strong correlation between digital literacy and students' cognitive abilities in ecology courses, with 62.6%. Learning that utilizes technology will increasingly develop so that digital literacy in the educational environment is beneficial for students in covering broader and deeper information. It helps students complete assignments and finds accurate information.

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