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DEVELOPING THE BIOLOGY DIGITAL COMICS AS THE MEDIA FOR LEARNING OF HUMAN CIRCULATORY SYSTEM

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Abstract: *The purpose of this study was to create digital comics on biology and assess their suitability and effectiveness as a teaching tool for the human circulatory system for eleventh graders in terms of learning outcomes. The approach used an R&D model that was modified from the Borg and Gall model. Subjects included pupils from SMA Negeri 1 Kisaran and SMA Negeri 4 Kisaran. The data of interviews, questionnaires, and multiple choices were obtained. The findings demonstrated the validity of the eligibility level of the biology digital comics created; 94% of the material experts, 89% of the instructional design experts, and 94% of the layout experts evaluated the comics. With an average score of 88%, the created educational materials that were evaluated by students fell into the very good category. In the meantime, the effectiveness level of biology digital comics with an N-Gain value of 0.57 in a moderate category and the eligibility level gained from the teachers was 90% in a very good category.*

Keywords: *Learning media, digital comics, biology, circulatory system*

Abstrak: Tujuan dari penelitian ini adalah membuat komik digital mata pelajaran biologi dan menilai kesesuaian dan efektivitasnya sebagai alat bantu pengajaran sistem peredaran darah manusia untuk siswa kelas XI ditinjau dari hasil belajar. Pendekatan yang digunakan adalah model R&D yang dimodifikasi dari model Borg and Gall. Subyek penelitiannya adalah siswa SMA Negeri 1 Kisaran dan SMA Negeri 4 Kisaran. Data diperoleh melalui wawancara, angket, dan pilihan ganda. Temuan tersebut menunjukkan validitas tingkat kelayakan komik digital biologi yang dibuat; Komik dinilai oleh 94% ahli materi, 89% ahli desain pembelajaran, dan 94% ahli tata letak. Dengan skor rata-rata sebesar 88%, materi pendidikan yang dibuat dan dinilai oleh siswa masuk dalam kategori sangat baik. Sedangkan tingkat keefektifan komik digital biologi dengan nilai N-Gain sebesar 0,57 berada pada kategori sedang dan tingkat kelayakan yang diperoleh dari guru sebesar 90% berada pada kategori sangat baik.

Kata kunci: Media pembelajaran, komik digital, biologi, sistem peredaran darah

PENDAHULUAN

Learning media is a very important element in its existence apart from the presence of teachers and students. Learning media can be used as a solution to overcome the difficulties faced by students. The use of this media will indirectly increase the involvement of various sensory devices in exploiting a teaching material that is conveyed by the teacher to students. Acquiring The combination of new experiences and previously encountered experiences can lead to changes in knowledge and skills, attitudes, and behavior.

Dale (1969) in estimates that the acquisition of learning outcomes through the visual sense around 75%, through the sense of hearing around 13%, and through other senses around 12%. In using the media, it is necessary to find out the basis or reference for using the media. The basis that is often used in references to the use of this media is Dale's Cone of Experience.

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This cone of experience was put forward by Edgar Dale. This cone is the result of an clarification of Bruner's proposed three degrees of experience. Learning outcomes for an individual are derived from concrete experiences, such as real-world situations, followed by artificial objects and linguistic symbols (abstract).

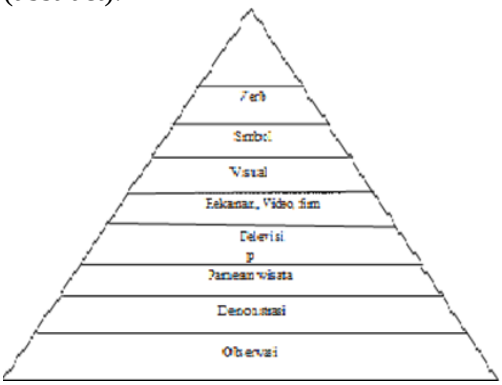

Figure The Chart of Dale's Cone of Experience

Koballa in defines science as a way of thinking, a way of investigating, a body of knowledge, and its interactions with technology and society. It can be said that science has dimensions of a way of thinking, a way of investigation, a foundation of knowledge and a relationship with technology and society. This is the basic substance of the importance of science learning which develops the process of forming students' thinking.

Textbooks mostly in the form of printed textbooks these days; while there are differences in the number of illustrations included, they haven't had enough of an impact on raising students' enthusiasm in reading. Low reading interest leads to low learning outcomes and low levels of activity. Students' interest in reading textbooks is diminished by the intricacy of the instructional materials provided, including textbooks on biology. Compared to textbooks, students are more likely to enjoy reading picture story books, like comics, because they have a clear, well-organized plot that makes it simple to recall. As many as 91% of students have read comics from various media such as newspapers, magazines, comic books, and the internet. This is where the idea emerged to combine the attractiveness of comics, including attractive appearance, coherent flow and easy to understand, with textbooks that tend to be textbooks. so that students are interested in reading it.

Comic is one of the medium that attracts the attention of its readers, equipped with the action of the characters which are made more alive, and processed by using the main colors clearly. Reading pictorial reading is not only loved by children but also adults, with an entertaining nature such as playing but a seriousness in obtaining meaning.

Based on the results of study conducted by, the use of science comics can improve learning outcomes compared to textbooks. also obtained results of an increase in cognitive, affective and psychomotor learning outcomes with the use of comics in the integration of science lessons with local wisdom. Stated in his previous study, pictorial comics learning media can improve students' learning outcomes in terms of score gains including moderate category, increase students' activities and interests and also obtain the positive responses from students and teachers. The use of comic media in learning activities has been proven to be effective in stimulating student motivation. High student motivation in learning process can produce good learning outcomes. Concluded that students are motivated because comics are humorous. The comics are visualized in the form of frames/boxes and speech balloons that are more than one but one unit, so that comics are useful as learning media. The results of study by showed that the use of comic media in learning provides satisfactory results. This can be seen in the achievement of student learning motivation, understanding student concepts, and student responses. Also stated that the use of comics can motivate

students to learn. This can be seen from the students' learning outcomes obtained through measuring the cognitive, affective and psychomotor domains. This has proven from previous research that the use of comics as a learning media is very effective and feasible.

Nowadays, the world has been impacted by the Covid-19 Pandemic, nearly 300 million students have been disrupted by their school activities around the globe. Until now, schools in Indonesia have implemented distance teaching and learning activities and online-based learning by utilizing the Edmodo application, Google Classroom, Zoom, WhatsApp and so on. It is recognized that the use of digital comic media can help the online learning process, especially helping to increase student interest, motivation, and learning outcomes.

According to, digital comics are environmentally friendly, cost-effective, and flexible. It is said to be environmentally friendly because digital comics do not use paper as a delivery media so that we can save paper usage. Digital comics are said to be cost-effective because they don't need to be printed, bound, and duplicated in the form of a book. Digital comics are also said to be flexible because they can be accessed easily anytime and anywhere.

METODE

The method applied a Research and Development (R&D) adapted from. The stages of this model are as follows: 1) research and information gathering; 2) planning; 3) developing; 4) initial field tests; 5) revision; 6) main field tests; 7) revision; 8) operational field tests; 9) revision; 10) product implementation. Of the ten steps, the researchers grouped them into four stages; 1) the initial research stage, consisting of information gathering and planning; 2) development stage; 3) the testing phases, consisting of expert team validation, initial field tests (small-group tests), main field tests (limited-group tests), and operational field tests (large-group tests), suggestions from the test results will be used as material for product improvement revisions; and 4) product implementation. The data of interviews, questionnaires, and multiple choices were obtained . There were 9 students as the subjects of the small-group tests at SMA Negeri 1 Kisaran, the limited-group tests consisted of 40 students of SMA Negeri 4's XI IPA-1 Kisaran, and the large-group tests were employed to 76 students from 2 schools; 39 students of 37 additional XI IPA-1 students at SMA Negeri and XI IPA-2 students at SMA Negeri 1 Kisaran 4 Kisaran.

HASIL DAN PEMBAHASAN

At the stage of initial study, the researcher carried out the curriculum, needs problem and concept analysis in determining the developed products. Based on the needs analysis, it showed that the teachers applied various methods and techniques in learning biology, including lectures, discussions, and practices. The media that were often used in schools were videos, worksheets, charts, and also the school environment.

At the stage of product development, it contained the design of the products to be developed. The development of biology digital comics began with the making of a story script from the human circulatory system, then creating an image through Photoshop CC-2020.

At the testing stage, the validation and tests were carried out to determine the eligibility of the developed products. The validations were carried out by two material experts, two instructional design experts, and one layout expert. Meanwhile, the tests were conducted by two biology teachers at SMA Negeri 1 and SMA Negeri 4 Kisaran, and the tests to students consisted of small-group, limited-group and large-group tests. Based on the validation results of two

material experts consisting of The average proportion of eligible content from the experts was 94%, in which the mean percentage of the material was 93%. In the aspect of the presentation technique, it obtained the mean score of 93%. The supporting aspects of the material presentation obtained the mean percentage of 96%. The results gained led to the conclusion that the biology digital comics were suitable for use as a learning media. For additional information, see Fig. 2 for the empirical graph data collecting results.

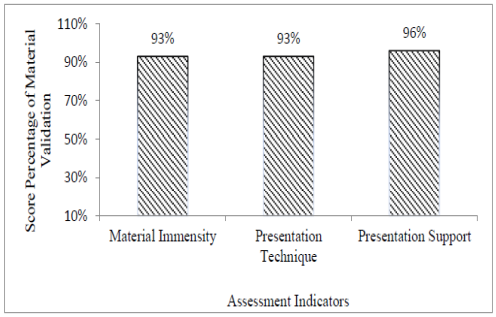

Figure The Assessment of Learning Media from Material Experts

From the result aforementioned above, it showed that the digital comics were suitable to use. However, there were several comic revisions that were made based on the suggestions from the two experts, including correcting errors in typing writing, some materials were still lacking in depth so it must be searched from human physiology books, and images about leukocytes were shown as relevant, in the chapter of the heart it has not discussed about the heart work and activities that affect heart work, as well as material about blood types that have not yet appeared, changing the concept of pathways in blood circulation, and adding supporting references to the bibliography.

Based on the validation results of the instructional design experts, it showed that the mean score of the assessment was 97%. The assessment of the efficiency component for learning from the experts was 85% and from the linguistic component was 85%. The overall mean score of the assessment was 89% in a very good category according to the experts. For additional information, see the empirical graph data acquisition results shown in Fig. 3.

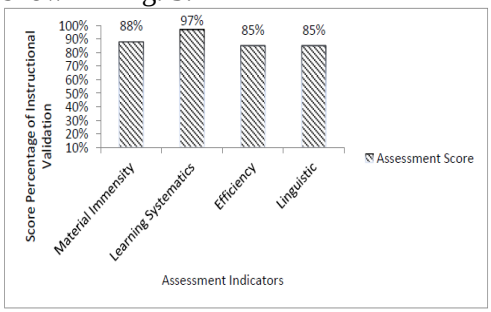

Figure The Assessment of Learning Media from Instructional Design Experts

Based on the validation results of the instructional design experts, the digital comics were suitable for use in a very good category. Product revisions were made based on the suggestions from any experts. These suggestions were to make an introductory dialogue at the beginning of the chapter and try to make one analysis question, the column was conveyed through comic characters, and for the purpose of learning it was better to use verbs that could be measured, and at the end of a sentence in comics replaced with acknowledgments, as well as correcting typing errors and punctuation.

Based on the validation results of the the layout experts, it showed that the mean score of the graphics component was 92%. The assessment of comic illustration was 94%, the comic cover/typography was 92%, the programming was 100%, and the content illustration was 94%. The overall mean score of the assessment from the experts was 94% in a very good category. For additional information, see the empirical graph data acquisition results shown in Fig. 4.

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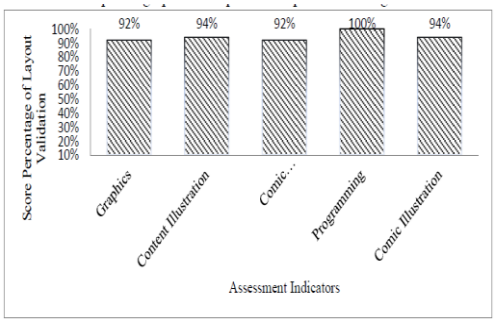

Figure The Assessment of Learning Media of Layout Experts

In terms of layout, it showed that digital comics were very good and suitable for use in learning. As for some of the suggestions provided by the experts; setting the left and right alignment, 1.15 spacing and Sansserif fonts, and giving color to the character's background, as well as giving color to comics and removing empty boxes on some pages, as well as giving images to the author's part.

The results of the analysis from two biology teachers showed the appearance component was
90%, the assessment of the material presentation was 83%, the significance was 91%, and the comic feasibility was 97%. The overall mean score of the assessment from biology teachers on biology digital comics was 90% in a very good category. For additional information, see the empirical graph data acquisition results shown in
Fig. 5.

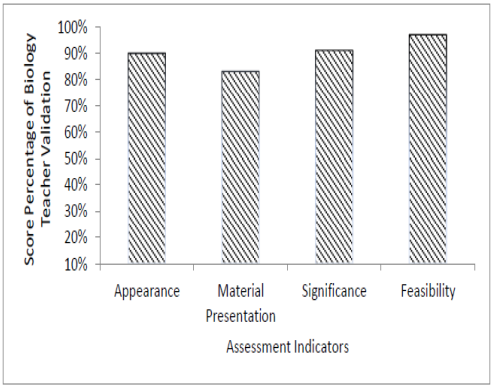

Figure The Assessment of Learning Media of Biology Teachers

The biology digital comics were quite good and had a different appearance from textbooks so that they could be used because they were interesting to read. The suggestions that were given including the content or information displayed through the comics was still minimum, not entire things in the textbook were included in the comic, the image of the white blood cells was still incomplete, the heart also has not explained the work of the heart clearly, the information of human circulatory diseases from the chapter was still too little, and the writing could still be improved a little more so that the comics could be even better.

Based on The results of the individual product tests indicated that, with a mean percentage of 88%, the nine students who were employed fell into the good or eligible category. The testing involving limited groups with a sample of 40 students demonstrated that they were in a good or qualifying category with a mean percentage of 85%. The large-group tests with a sample of 76 With a mean percentage of 91%, pupils demonstrated that they were in a good or eligible group. For further information, see the empirical graph data acquisition results shown in Fig. 6.

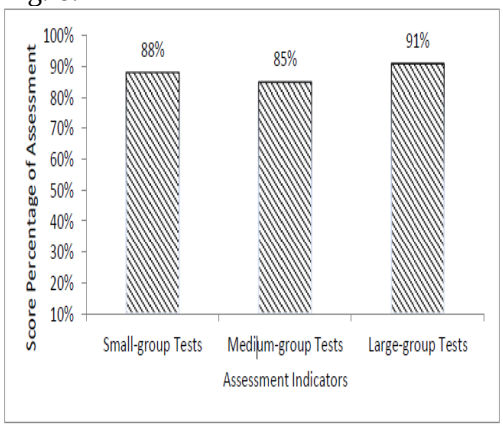

Figure The Assessment of Biology Digital Comics Based on the Small-, Medium- and Large-group Tests.

The biology digital comics were effective as a learning media because students in the 21st century are part of the digital native generation. This is in line with the problems that occur in the world, especially in Indonesia which is severely impacted by the Covid-19 pandemic, so that these digital comics were effective

for use in online learning, which were distributed directly when learning through WhatsApp group.

SIMPULAN

Based on the results and discussion aforementioned above, it was concluded that (1) the biology digital comics could be developed through Adobe Photoshop CC-2020 software; (2) the eligibility level of learning media was obtained through 1) the assessment of the experts containing a) the assessment score of the material experts was 94% in a very good category, the instructional design experts was 89% in a very good category, c) the layout experts was 94% in a very good category; 2) the assessment of biology teachers was 90% in a very good category; 3) the assessment of students for the small-group test was 88% in a very good category; 4) the medium-group test was 85% in a very good category; and 5) large-group test was 91% in a very good category. It means that the biology digital comics on human circulatory system were suitable for use as a learning media for the eleventh grade students.

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