JIPVA (JURNAL PENDIDIKAN IPA VETERAN)

Volume 7 - Nomor 2, 2023

Available at http://e-journal.ivet.ac.id/index.php/jipva

ISSN : 2598-5876 (print), 2598-0904 (online)

The Validity of STEM-Based Digital Comic Media on the Topic of the Structure And Function of Human Respiration

Maisyatul Hasanah, Haning Hasbiyati*, Siti Roudlotul Hikamah
Biology Education Study Program, Faculty of Education and Teacher Training, Universitas Islam Jember
*Coressponding author email: haninghasbiyati@gmail.com

Artikel info

Received : 17 Oct 2023
Revised : 25 Nov 2023
Accepted : 30 Nov 2023

Kata kunci:
Digital comic media
Human respiration
STEM

ABSTRACT

Learning media is anything that is capable of conveying a message, influencing the minds, emotions, and motivations of learners, thereby fostering the creation of the learning process within them. The results of interviews conducted with Natural Sciences (IPA) teachers at one of the MTs in Jember can be summarized as follows: the use of learning media is still not optimal, while the structure and function of the human respiratory system remain abstract and related to everyday life. This research aims to determine the validity of a STEM-based digital comic media with the subject of the structure and function of the human respiratory system. This study utilizes a research and development method with the Plomp development model, which consists of three stages: initial research, prototype development, and evaluation. The results of this development research obtained a score of 83.11%, categorized as highly valid for media validation, and 86.66%, categorized as highly valid for material validation. Based on the research results at the MTs, it can be concluded that the STEM-based digital comic media on the topic of the structure and function of the human respiratory system is valid for use.

https://doi.org/10.31331/jipva.v7i2.3010

How to Cite: Hasanah, M., Hasbiyati, H., & Hikamah, S.R. (2023). *The Validity of STEM-Based Digital Comic Media on the Topic of the Structure And Function of Human Respiration*. *JIPVA (Jurnal Pendidikan IPA Veteran), 7(2),* 143-155.doi: https://doi.org/10.31331/jipva.v7i2.3010

INTRODUCTION

In the 21st century, there have been many changes, especially in the fields of education and technology. One notable change is the demand for educators to master technology in order to enhance learning through the use of instructional media (Sasmitha et al., 2023). Instructional media plays a significant role in supporting the teaching and learning process. Teachers use instructional media as a medium to deliver learning materials to students. The use of instructional media in the teaching and learning process can influence students' motivation and interest in learning, and even have psychological effects on learning (Wulandari et al., 2023).

Instructional media serves as a tool to facilitate the delivery of messages and enhance students' understanding of learning materials (Ndraha & Harefa, 2023).Instructional media can

boost students' enthusiasm for learning and stimulate their curiosity about the subject matter. Without interest and motivation for learning, the learning process will not be successful.

The success of student learning also comes from teachers who are educators (Syafi'i et al., 2018). Based on the results of interviews conducted by researchers with science teachers on October 19, 2022, at one of the MTs located in Jember. it was concluded that the utilization of learning media was still not optimal, even though the school already had media tools such as computer laboratories, LCDs, projectors, and loudspeakers. Teachers only use LKS books and lectures that are assisted by drawing on the blackboard during science learning, but this has not been able to optimize students' thinking skills. Media is defined as a tool to capture, process and convey visual information (Narestuti et al., 2021).

Comics serve as a tool capable of educating students visually (Hanum, 2022). Furthermore, comics can inspire students to read and serve as a source of imagination(Aulia et al., 2020). Meanwhile, technological advancements cannot be avoided, as they align with the development of science (Hulwani et al., 2021). One example of current technological advancement is the smartphone, which supports the development of science through educational media. The benefits of media supported by smartphones can enhance student learning outcomes, as well as simplify and expedite the learning process (Hasbiyati, 2020).

In accordance with current developments, all technology-based media, one of which is digital comic media. Digital comics are easier to access and easy to make (Pinatih, 2021). Some researchers use digital comics as learning media. This opinion is reinforced by findings from other studies in class VIII B MTs Ma'arif Ambulu. The results of the study concluded that the utilization of learning media in the form of digital comics can result in an increase in student learning achievement (Narestuti et al., 2021). But not only digital comics, the application of ordinary comics in learning can also optimize student learning outcomes (Kamil et al., 2022).

In addition, digital comics do not make it difficult for students to gain an understanding of learning material (Fardiana et al., 2022). Digital comics can foster students' interest in reading (Nuriza et al., 2022). Digital comics are media that are said to be valid and practical to use in learning (Khadar et al., 2022). Digital comics can also help students think critically in learning (Jannah & Atmojo, 2022).

Improving student learning achievement is not only dependent on learning media, but also greatly influenced by effective approaches. Science, Technology, Engineering, and Mathematics (STEM) is one approach that is very supportive in learning (Sumaya et al., 2021). STEM not only provides support for the development of logical, analytical, critical, and creative thinking skills, but also has the potential to motivate teachers in teaching (Sukmagati et al., 2020). STEM-based learning has an impact on the learning atmosphere to be more active so that it can improve student learning outcomes for the better (Wahyuni, 2021).

The STEM approach is also used to overcome the problem of student disinterest in learning Science subjects with conventional teaching and learning methods (Fern et al., 2020). Implementing the STEM approach in the national curriculum structure has great potential to produce more optimal learning outcomes and have a positive impact on implementation and learning outcomes, especially in science subjects with a focus on biological material (Lestari et al., 2018). Biology is the study of the physical structure and function of the human body and surrounding creatures. One of the biology materials is the structure and function of human respiration.

The material that discusses the structure and function of human breathing helps students understand the various respiratory organs and their respective roles, the mechanism of human breathing, and aspects of respiratory frequency and volume. This material is abstract so the application of this material in the form of digital comics with a STEM approach is very relevant. This approach will motivate students to actively participate in designing, developing, applying, and utilizing knowledge and technology through digital comic platforms (Handayani, 2021).

Material that discusses the structure and function of human respiration can be difficult to understand if only taught by studying and memorizing. This is because this material is abstract and involves understanding the various organs associated with the respiratory system and their functions (Wicaksono & Widiyaningrum, 2020).

The solution to this problem is that the researcher conducted a test entitled "The validity of STEM-based Digital Comic Media on the Material of Human Respiratory Structure and Function", the aim is to produce interesting and useful development products so as to increase students' enthusiasm for learning and not make it difficult for students to understand the material. It is hoped that with STEM students can feel more involved in the learning process and gain learning experience.

METHOD

Type of Research

Research and Development with Plomp's development model is the method used in this study. Plomp's development involves 3 main steps, namely the initial research stage, the prototype stage and the evaluation stage (Plomp, 2010).

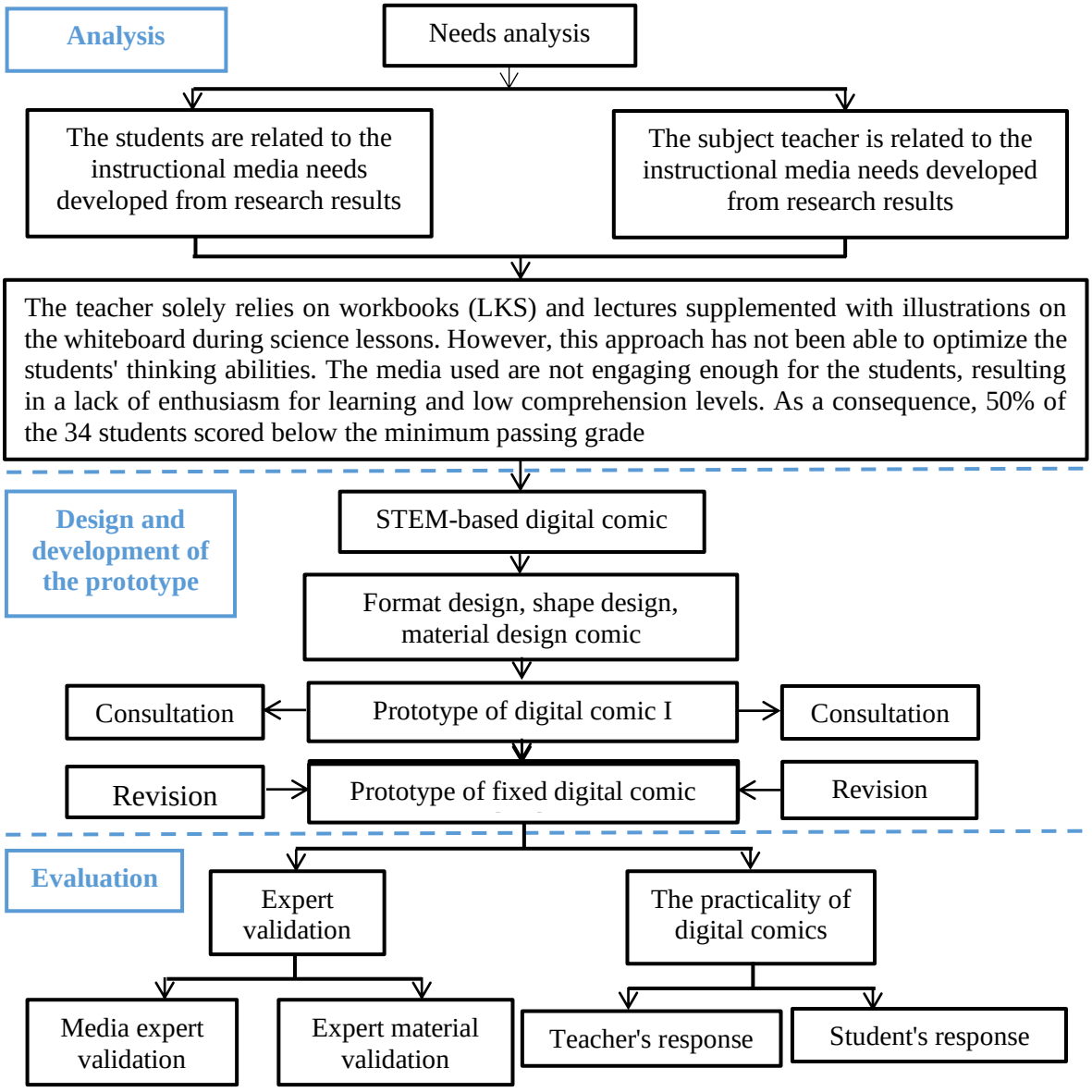


Figure 1. Research Stages of Digital Comic Media Development Adapted from Plomp Model

Time and Location of the Study

In the even semester of the 2023/2024 academic year, researchers conducted a trial of digital comic media in one of the MTs in Jember district.

Population and Sample

Students of class VIII (A & B) are the population in this study. In this population using purposive sampling, 6 students were taken.

Research Procedure

The description of the stages of research on the validity of digital comic media, adapted from the Plomp model, is described as follows:

Analysis stage

The purpose of analysis can find out a problem that occurs in the classroom so that a learning device development is needed. Researchers conducted interviews to identify problems in classroom learning. The interview was conducted directly with the science teacher.

Design and Development Stage

In this stage, researchers began to design and develop digital comic media. The following steps were taken:

Design Stage

The design stage steps that need to be taken are conceptualization, material compilation, media selection, format design, and tool design.

Design and Development Stage

At this stage, the goal is to develop the design into STEM-based digital comic media in consultation with the supervisor. Suggestions and revisions from the supervisor will then be used to improve the design and completeness of the material, providing a basis for design improvement.

Evaluation stage

The purpose of this stage is to determine validity and practicality. There must be an instrument sheet to know the validity of a medium and material. After that, in order to find out the practicality of the media in general, a practicality test was carried out with the responses of science teachers and 8th grade students. Researchers collected data by distributing questionnaires and determining the results of the analysis, which became the basis for knowing whether the media was suitable for use.

The assessment to determine the analysis results of the questionnaire has several aspects. In media validation, there are three aspects that must be met: media appearance (4 indicators), media content (10 indicators), and media functionality (6 indicators). Meanwhile, in material validation, there are two aspects: media content (15 indicators) and language (5 indicators) (Kiftia & Rukmi, 2022). Additionally, the evaluation of practicality testing is obtained from teacher and student responses. The assessment instruments for teacher responses consist of three aspects: appearance (4 indicators), media content (10 indicators), and practicality (6 indicators), while for student responses there are 20 indicators (Kiftia & Rukmi, 2022).

Data, Instruments, and Data Collection Techniques

The technique for obtaining information is through the distribution of evaluation questionnaires to media validators and material validators, as well as evaluation questionnaires to teachers and students for these digital comics. Data from the validation results as a reference in evaluating and determining the feasibility of the media in learning.

Data analysis technique

The technique of obtaining information in this study uses direct observation methods, interviews, distribution of questionnaires accompanied by documentary evidence. The questionnaire is in the form of media and material assessment instruments for validation testing. Likert scale is used for media and material validation. Below is the formula for calculating the results of the Likert scale:

$$P = \frac{\sum x}{\sum x_1} \times 100\%$$

Description:

P = Average percentage

$\sum x$ = Number of data collected

$\sum x_1$ = Total number of values

Source (Ridwan, 2013:15)

Based on this formula, the validation of digital comic media can be determined based on the following criteria:

Table 1. Likert Scale Criteria

Percentage	Category
81,25% - 100,00%	Very valid, no revision
62,05% - 81,25%	Valid, needs minor revision
43,75% - 62,05%	Not very valid, needs major revision
25% - 43,75%	Invalid, must not be used
00,00% - 25%	Highly invalid, do not use

Source : Adapted from(Akbar, 2013)

RESULTS AND DISCUSSION

Based on interviews with science teachers at MTs, it is concluded that the use of learning media is still not optimal, while the material on the structure and function of human respiration is abstract and directly related to life. The way to overcome this problem is by developing STEM-based digital comic media. Digital comic media can enhance students' learning motivation and not complicate students' understanding of the material. It is hoped that with the presence of STEM, students can feel more engaged in the learning process and gain learning experiences.

After the research was conducted from May 23, 2023, to May 25, 2023, a percentage of 83.11% was obtained in the highly valid category, and the material validity test yielded a percentage of 86.66% in the highly valid category. Therefore, it can be concluded that STEM-based digital comic media on the topic of the structure and function of human respiration is highly valid for use.

Analysis Stage

In the analysis stage, the researchers conducted interviews to identify problems in classroom learning. The interview was conducted directly with the science teacher. Based on the results of the interview, it was found that the use of media in the school was not optimal, learning was done in a conventional form supported by LKS books and drawing on the

blackboard, which made learning less interesting. Because of these problems, there is a need for learning media that can encourage students to learn. Researchers developed STEM-based digital comic media based on the material of the structure and function of human respiration. This STEM-based digital comic media encourages students to develop skills such as logical thinking, analytical, critical, creative, innovative, problem solving and decision making, as well as discussion and cooperation with each other, so that they can effectively communicate their solutions to real problems

Design and Development Stage

This stage is to carry out activities to design and develop digital comic media. The design stage consists of 5 stages, namely:

Concept Development

Researchers developed STEM-based digital comic media for class VIII SMP / MTs even semester. STEM-based digital comic media was developed as a teaching and learning support to facilitate and accelerate the learning process and make learning more interesting and integrate the material of human respiratory structure and function so that the developed media will contain each component of the STEM aspect.

The STEM components will be presented in the comic in an engaging and compelling manner, using an intriguing combination of visualization and challenging narratives to stimulate students' interest and enthusiasm for learning. By showcasing the practical application of STEM concepts in everyday life, it is hoped that this comic will inspire students to deepen their understanding of science, technology, engineering, and mathematics. The details regarding the STEM concepts to be explained can be outlined as follows:

Science:

a) Elaborating deeply on topics relevant to science, such as the structure and function of the human respiratory system.
b) Utilizing captivating illustrations and narratives to assist in understanding complex scientific concepts.

Technology:

a) Introducing relevant technological tools, such as respiratory volume measuring devices or the latest medical equipment related to respiration.
b) Demonstrating how technology is used to understand and address issues related to the topic.

Engineering:

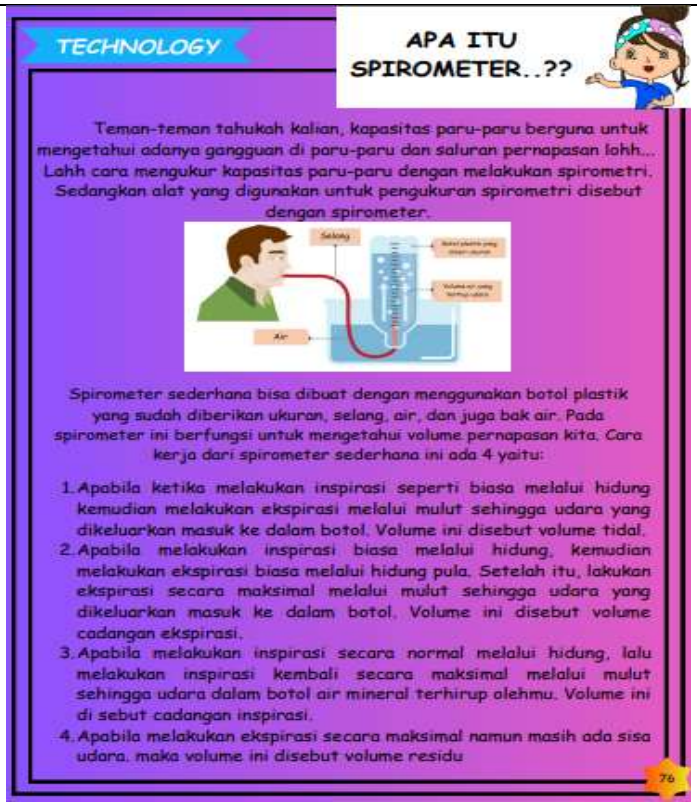
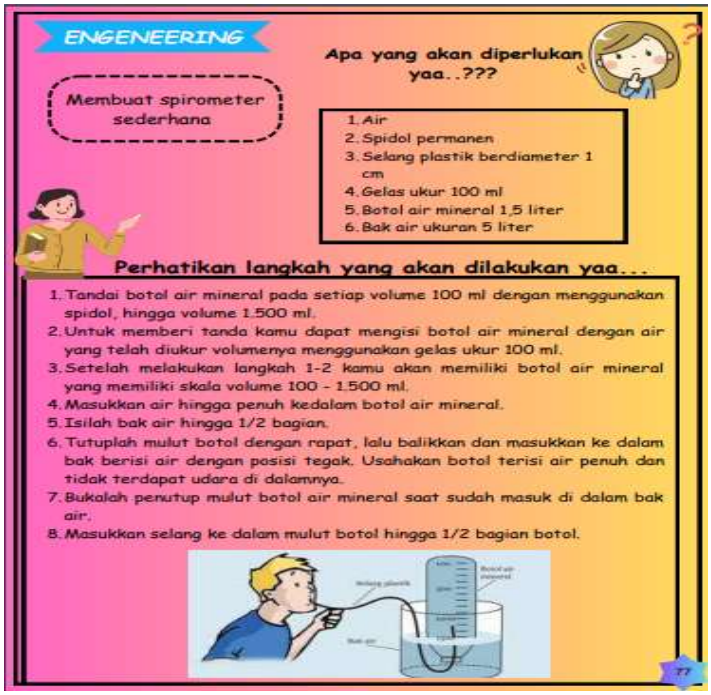
a) Presenting engaging engineering projects or experiments that can be understood by students, such as creating a simple respiratory volume measuring device or designing an artificial respiratory system.
b) Highlighting how engineering is utilized to design practical solutions to challenges associated with respiration.

Mathematics:

a) Integrating relevant mathematical calculations related to the topic, such as calculating respiratory volume based on measured data or conducting statistical analysis related to respiratory issues.
b) Demonstrating how mathematics is used as a tool to analyze and understand data in a scientific context.

Table 2. STEM Concept

STEM Concept	STEM aspect
Science	All knowledge contained in digital comics, including: understanding of human respiration, structure and function of human respiration, human respiratory organs, human respiratory mechanisms, human respiratory frequency, and human respiratory volume. 
Technology	Introducing a simple technology for measuring human respiratory volume

STEM Concept	STEM aspect
	
Enggenerring	Designing and constructing a simple measuring device to measure human respiratory volume. 
Mathematich	The mathematics involved in this research is calculating the volume entering the bottle during the laboratory experiment to measure human respiratory volume.

STEM Concept	STEM aspect
	

Preparation of Material

The STEM-based digital comic media developed discusses material related to respiratory structure and function. This material includes: 1) definition of human respiration; 2) respiratory organ system; 3) human respiratory process; 4) human respiratory frequency; 5) human tidal volume.

Media Selection

The learning media developed are digital comic media. This media selection is adapted to the problem and needs analysis stage. The use of digital comics can be used by students individually and at any time.

Format Design

Once the material has been compiled, the next step is to create a digital comic format. Digital comics are designed using the Canva application and also using the Ibispaint X application. The steps for creating digital comics are as follows: 1) Draw characters that will be used as player characters in comics on books or blank sheets; 2) Redraw the characters in the IbisPaint application; 3) Researchers create the right atmosphere and also a fresh environment; 4) Then combine the character with the environment through the Canva application; 5) Researchers refine the combination so that it becomes digital comic media; 6) When finished, researchers save in the form of PDF Standard because it is easy to use.

Instrument Design

The stages of instrument design include media validation instruments and content validation instruments. In media validation, there are three types: the display of digital comic media containing 4 indicators, the content of digital comic media containing 10 indicators, and the function of digital comic media containing 6 indicators. Meanwhile, in content validation,

there are 2 aspects: the content of digital comic media with 15 indicators and the language with 5 indicators.

Evaluation phase

Before conducting the research, the digital comic is validated by validators. The validation is done by the lecturers of Biology Education from Universitas Islam Jember.

Results of Media Validation

The results of media validation are shown in the following table:

Table 3. Results of Media Validation Test

No.	Evaluation Aspects	Score (%)	Category
1.	Presentation of Digital Comics	80%	Valid
2.	Content of Digital Comic Media	86%	Very valid
3.	Function of Digital Comics	83,33%	Very valid
	Average score	83,11%	Very valid

Source: Personal document, 2023

Based on the table above, we can see that the average score for each aspect is 83.11%, broken down as follows: for the display aspect of the digital comic, it's 80%; for the content aspect of the digital comic, it's 86%; and for the function aspect of the digital comic, it's 83.33%. These results indicate that the digital comic is highly valid for use. The results of the media validation are also shown graphically in the following figure:

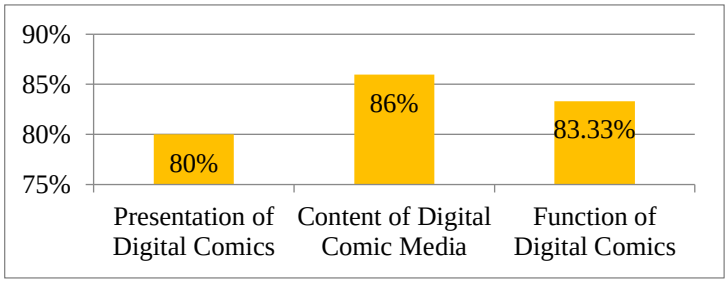


Figure 1. Media Validation Results Graph

Content Validation Results

The results of the content validation test are shown in the following table:

Table 4. Content Validity Test Results

No.	Evaluation Aspects	Score (%)	Category
1.	Content of digital comics	85,33	Very valid
2.	Language	88	Very valid
	Average score	86,66%	Very valid

Source: Personal document, 2023

Based on the table above, the content validation results obtained an average score of 86.66%, broken down as follows: for the content aspect of the digital comic, it's 85.33%, and for the language aspect, it's 88%. These results show that the digital comic is highly valid and does not need to be revised. The results of the content validation are also shown graphically in the following figure:

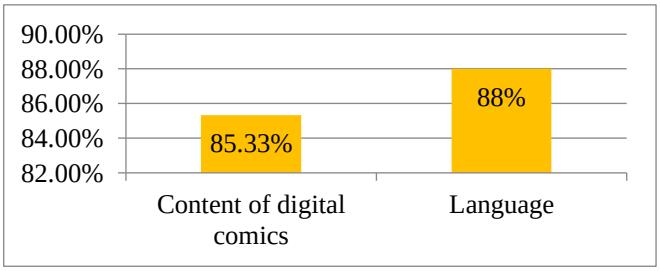


Figure 2. Content validation results graph

CONCLUSION AND SUGGESTION

Conclusion

Based on the research conducted in one of the MTs in Jember, the media validity test obtained a percentage of 83.11% in the highly valid category, and the content validity test obtained a percentage of 86.66% in the highly valid category. Therefore, it can be concluded that the STEM-based digital comic media on the structure and function of human respiration is highly valid for use.

Suggestion

This study was limited to product testing only. It is hoped that other researchers can continue and develop more engaging learning media so that students can be more enthusiastic in their learning.

REFERENCE

Aulia, J., Permana P, N. D., Zarkasih, Z., & Nova, T. L. (2020). Meta-Analisis Pengaruh Penerapan Pendekatan Saintifik Berbantuan Komik terhadap Hasil Belajar IPA Siswa SMP. *Journal of Natural Science and Integration*, *3*(1), 70. https://doi.org/10.24014/jnsi.v3i1.9617

Akbar, S. (2013). Instrumen Perangkat Pembelajaran (Kedua). PT Remaja Rosdakarya

Fardiana, N. K. R. S., Nurhakim, S. S., & Latip, A. (2022). Media Berbasis Komik Pada Pembelajaran IPA: Analisis Karakteristik, Bentuk, dan Dampak dalam Pembelajaran. *Jurnal Kajian Pendidikan IPA*, *2*(2), 82. https://doi.org/10.52434/jkpi.v2i2.1977

Fern, K. S., Effendi, M., & Matore, E. M. (2020). Pendekatan STEM dalam proses pengajaran dan pembelajaran: Sorotan Literatur Bersistematik (SLR). *10*.

Handayani, T. (2021). Pengembangan Media Komik Digital Berbasis STEM untuk Meningkatkan Literasi Sains Siswa Sekolah Dasar. *Jurnal Didaktika Pendidikan Dasar*, *5*(3), 737–756. https://doi.org/10.26811/didaktika.v5i3.343

Hanum, A. S. (2022). Elektronik Komik Ekosistem (E-Mikosis) Bermuatan Kearifan Lokal Untuk Meningkatkan Kecerdasan Spasial IPA. *WASIS : Jurnal Ilmiah Pendidikan*, *3*(1), 45–52. https://doi.org/10.24176/wasis.v3i1.7791

Hasbiyati, H. (2020). Analisa Efektifitas Penerapan Media Pembelajaran Berbasis Smartphone Pada Peningkatan Hasil Belajar Biologi. *Bio-Lectura*, *7*(1), 10–14. https://doi.org/10.31849/bl.v7i1.4034

Hulwani, A. Z., Pujiastuti, H., & Rafianti, I. (2021). Pengembangan Media Pembelajaran Interaktif Android Matematika dengan Pendekatan STEM pada Materi Trigonometri.

Jurnal Cendekia : Jurnal Pendidikan Matematika, *5*(3), 2255–2269. https://doi.org/10.31004/cendekia.v5i3.717

Izzati, N., Tambunan, L. R., Susanti, S., & Siregar, N. A. R. (2019). Pengenalan Pendekatan STEM sebagai Inovasi Pembelajaran Era Revolusi Industri 4.0. *Jurnal Anugerah*, *1*(2), 83–89. https://doi.org/10.31629/anugerah.v1i2.1776

Jannah, D. R. N., & Atmojo, I. R. W. (2022). Media Digital dalam Memberdayakan Kemampuan Berpikir Kritis Abad 21 pada Pembelajaran IPA di Sekolah Dasar. *Jurnal Basicedu*, *6*(1), 1064–1074. https://doi.org/10.31004/basicedu.v6i1.2124

Kamil, A., Hasbiyati, H., Afandi, B., & Hasbiyati, H. (2022). Penerapan Media Komik Materi Klasifikasi Makhluk Hidup Untuk Meningkatkan Hasil Belajar Siswa. *11*.

Khadar, R. S. F., Rahmat, D., & Saepuloh, L. (2022). Pengembangan Media Komik Digital Mata Pelajaran Ipa Kelas Vii Di Smp Muhammadiyah Sukabumi. *2*.

Kiftia, S. M., & Rukmi, A. S. (2022). Pengembangan Media Video Animasi Untuk Keterampilan Menyimak Teks Eksplanasi Siswa Kelas V Sekolah Dasar. *10*.

Lestari, D. A. B., Astuti, B., & Darsono, T. (2018). Implementasi LKS Dengan Pendekatan STEM (Science, Technology, Engineering, And Mathematics) Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Fisika dan Teknologi*, *4*(2), 202–207. https://doi.org/10.29303/jpft.v4i2.809

Narestuti, A. S., Sudiarti, D., & Nurjanah, U. (2021). Penerapan Media Pembelajaran Komik Digital untuk Meningkatkan Hasil Belajar Siswa. *Bioedusiana: Jurnal Pendidikan Biologi*, *6*(2), 305–317. https://doi.org/10.37058/bioed.v6i2.3756

Ndraha, H., & Harefa, A. R. (2023). *Pentingnya Media Pembelajaran dalam Meningkatkan Minat dan Motivasi Belajar Siswa di SMP Negeri 2 Gunungsitoli Utara*. *06*(01).

Nieveen, N. 1999. Prototyping to Reach Product Quality. Jan Van den Akker, Robert Maribe Braneh, Kent Gustafson, and Tjeerd Plomp (Ed), London: Kluwer Academic Publisher.

Nuriza, A. I., Suardana, I. N., & Selamet, K. (2022). *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia*. *5*.

Pinatih, S. A. C. (2021). Pengembangan Media Komik Digital Berbasis Pendekatan Saintifik pada Muatan IPA. *5*(1).

Plomp, T.. 2010. Generic Model for Educational Design (Problem, Analysis, Design, Implementation, Evaluation). *Enschede: University of Twente.*

Putra, D. D., Okilanda, A., Arisman, A., Lanos, M. E. C., Putri, S. A. R., Fajar, M., Lestari, H., & Wanto, S. (2020). Kupas Tuntas Penelitian Pengembangan Model Borg & Gall. *Wahana Dedikasi : Jurnal PkM Ilmu Kependidikan*, *3*(1), 46. https://doi.org/10.31851/dedikasi.v3i1.5340

Rahmawati, Ane Laksana Lintang., Nuraeni, Eni, & Ana Ratna Wulan. (2022). Pengaruh Pembelajaran Science Technology Engineering Mathematics (STEM) pada Materi Sistem Pernapasan terhadap Kemampuan Numerasi Siswa. *Assimilation: Indonesian Journal Of Biology Education*, *5*(2), 119–123.

Ridwan. (2013). Skala Pengukuran Variabel-Variabel Penelitian. *Alfabeta*: Bandung

Sasmitha, L. D., Hadiprayitno, G., Ilhamdi, M. L., & Jufri, A. W. (2023). Pengaruh Media Pembelajaran Berbasis Android terhadap Hasil Belajar dan Keterampilan Proses Sains Siswa. *5*.

Sukmagati, Oktaviani Putri, Yulianti, Dwi, & Sugianto, Sugianto. (2020). Pengembangan Lembar Kerja Siswa (LKS) Berbasis STEM (Science, Technology, Engineering, and Mathematics) untuk Meningkatkan Kemampuan Berpikir Kreatif Siswa SMP. *Unnes Physics Education Journal*.

Sumaya, A., Israwaty, I., & Ilmi, N. (2021). Penerapan Pendekatan STEM untuk Meningkatkan Hasil Belajar Siswa Sekolah Dasar Di Kabupaten Pinrang. *2021*.

Syafi'i, A., Marfiyanto, T., & Rodiyah, S. K. (2018). Studi Tentang Prestasi Belajar Siswa Dalam Berbagai Aspek Dan Faktor Yang Mempengaruhi. *Jurnal Komunikasi Pendidikan*, *2*(2), 115. https://doi.org/10.32585/jkp.v2i2.114

Wahyuni, N. P. (2021). Penerapan Pembelajaran Berbasis Meningkatkan Hasil Belajar IPA. *5*(1).

Wicaksono, B., & Widiyaningrum, P. (2020). Efektivitas Simulasi Drama Materi Sistem Pernafasan Terhadap Hasil Belajar Dan Sikap Kreatif Siswa. *Phenomenon : Jurnal Pendidikan MIPA*, *10*(1), 1–14. https://doi.org/10.21580/phen.2020.10.1.4084

Wulandari, A. P., Salsabila, A. A., Cahyani, K., Nurazizah, T. S., & Ulfiah, Z. (2023). Pentingnya Media Pembelajaran dalam Proses Belajar Mengajar. *Journal on Education*, *5*(2), 3928–3936. https://doi.org/10.31004/joe.v5i2.1074