

The Development of Science Comic in Human Digestive System Topic for Junior High School Students

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ABSTRACT The science education approach has covered by using printed teaching media. One of the popular printed press that most accessible and may used in science education is a comic book. However, it is sometimes difficult to find the ideal and the appropriate comic books that can be used as the instructional tool of science education, because most of them are inappropriate for learning science and did not fit with the readers' culture. The purpose of this study is to develop and evaluate the Science comic to contribute to science learning about Human Digestive System Topic (HDST) concepts. In this study, a science comic book was created and implemented to 92 students of year eight from three different junior high schools and three science teachers as a subject implementation development. Students' responses through the questionnaire and students-teachers' implementation test sheets evaluated through qualitative content analysis. The model used for this study is design and development. The result shows, most of the students agreed that science comic book helps them to learn through simplifying science concept and understanding the topic more accessible. The ideal science comic should also follow the right steps, appropriate aspects consisted, gain more science experience for both students and teachers to enjoy the learning process.

Keywords Instructional media, Science comic book, Human digestive system topic

1. INTRODUCTION

In many countries, the engagement of science education and communication has been emphasized using teaching media. Teaching media that is used usually in the form of printed media such as books, magazine, and newspaper (Falk, Storksdieck, & Dierking, 2007). The use of teaching media in science education is an essential issue because science education mostly appears through public media such as newspapers, magazines, radio, and television that people learn primarily about what they know about science (Detjen, 1995). In 2014, a survey from Media Studies Centre or Roper Centre found that 68% of the public get most of their science information in an environment from television, 59% from the newspaper, 32% from the magazine, and 30% from the radio. The result of the US government is even farther back at 24%, schools are 19%, and local businesses also corporations are far down the list at 11% and 9% (Detjen, 1995).

Among the popular media, printed media has a strong capability to communicate science education because they

are available to all various locations such as public or private (Gilbert & Lin, 2013). Although the availability of printed teaching media is useful and useful to use in science education, the content of teaching media itself should be covered the need to communicate the fascination, joy, and utility of science (Hosler & Boomer, 2011). The reality says differently; most of the printed teaching media cannot bring these needs; one of the common examples is a traditional science textbook. Among a variety of printed media, comics believed as a possible means of conveying scientific information that could cover fascination, joy and the utility of science because the contamination of humour as the specific feature of comics may attract many people's attention, interest, and enjoyment (Tatalovic, 2009).

Moreover, the production of science comics nowadays is not always to be proper by its way. Most of science comic

Received: 25 July 2019

Revised: 11 November 2019

Published: 28 November 2019

production focus on one aspect only without considering the sense of comic itself, and this condition aggravated by the fact that science comic for science teacher is sometimes challenging to find (Ozdemir, 2017). Therefore, the present science comic that is ideal for science teaching should develop along with this study.

This study focused on developing and evaluating some comic books that contribute to learning about the Human Digestive System topic. The topic is for 8th grade Junior High School students in the first semester. This topic chapter will emphasize the concept of the human digestive system process and organ's roles, also added by the effort to maintain the health of the social digestive system concept. This development focused on several aspects such as science content, sense of artwork that includes humour and uniqueness, and the language aspect to produce a better science comic book. The validation is conducted by the experts to check the suitability of science comics before science comics implemented to the science teachers and students for the pilot study.

The difference between comic strip and comic book in presentation aspect support that science comic book is more available to deliver the science information because both frames and words can explain the story. This statement supported by the fact that comic books and animated cartoons can use as media communication of education, especially in science education. Many common comics have put the reference about the scientific facts and ideas. Besides, comics are a popular art form, especially for children, and they provide a potential medium for science education and communication (Tatalovic, 2009). The development of science comics has been improved based on three aspects (Lin, Lin, Lee, & Yore) 2015) those aspects that have been considered consist of humour, contextualize learning, and visualize learning.

Discipline-specific knowledge of Biology has developed in the fields of developmental physiology and cognitive physiology. The investigation of children's knowledge about the concept in Biology, especially in the Human Digestive System Topic, formed has gathered momentum in pre-school education research in the last 30 years (Ahi, 2017). Through the amount of research, many researchers found that the biological knowledge viewpoint by the students is always increasing. There is a paucity of research that biological knowledge is ever-changing over time, and depending on the developmental process (Geerdts, Van de Walle, & LoBue, 2015).

On the contrary, Istikomayanti and Mitasari (2017) found that there are overcoming misconceptions in the learning process conducted by three teachers, neither certified nor uncertified. The result of students' misconception test mostly reached only level 3 or medium; thus, the study of the misconception of the digestive system material needs to get the attention of the teacher and educational practitioner.

With that explanation above, it can state that comic books may use as teaching media in the science classroom. However, how an instructional comic book should be designed and develop with scientific methods is not answered well. The purpose of this study is to develop a science comic book about the human digestive system and to get a review from the experts during the development. After the construction of a comic book has developed, the teachers' feedback through the comic also analyzed together with the students' questionnaire and implementation test sheets. The results will use as feedback for improving a better science comic book.

2. METHOD

2.1 Research Methodology

The research design used in this study is design and development. The development model used the following data input from several subject implementation. This type of research aiming to develop an instructional finding and solution to achieve a goal related to education or learning. This Research design working based on the existing theory and evidence, testing individual components, and get feedback in the development process.

This study had two main stages: development and evaluation of science comic book about human digestive system concept that started from identification of problem, formulating research objective, curriculum and content analysis, aspect measurement analysis, the construction of science comic which included the creative process of writing the first outline & storyboard and drawing the comic with expert reviews. The evaluation stage consists of the implementation and analysis of participants' responses. The participants' responses investigated through qualitative content analysis.

2.2 Material

This study has been passed several stages and reviews to develop the science comic book in the human digestive system. The study begins with the curriculum analysis as science content development. The standard curriculum used in this study following the Indonesian 2013 curriculum and focused on the process, organs, and how to maintain the health of the human digestive system.

After the science content analysis has constructed, the next stage is the analysis of science comic aspects as the measurement of this study. In brief, there are four aspects of science comics that are sought by this research. The aspects are consist of artwork, science content, language, and uniqueness. Those aspects would be used as the main aspects to help the reviewers and the students focus on giving feedback and suggestion through science comic development.

The feedback and score collected from the participant they give. The way how participants give the score is by providing an assessment gradient. Table 1 below shows the

Table 1 Assessment gradient on the rubric for each indicator measurement

Assessment (√) Gradient Scale				
Very Poor	Poor	Enough	Good	Very Good
1	2	4	5	6

Table 2 Students' questionnaire about human digestive system

No	Question	Aspect
1.	What is the story of the comic? Can you explain it using your own words?	General information about science comic
2.	Who are the characters of the comics? Can you call it one by one?	
3.	How is the process of digestion happen in the mouth?	Science content understanding
4.	During swallowing, the food that will transfer to the esophagus from the mouth will shape like a food ball. What is it called?	
5.	Why does the condition of the stomach should be acid?	
6.	Why should the small intestine be longer than the large intestine?	
7.	Please mention three accessory organs based on comics you have read!	Recalling knowledge
8.	What is the function of the appendix in the small intestine?	
9.	Why should we clean our hands after going back from the toilet?	
10.	Mention three good eating habits for humans, especially for children!	

assessment gradient of each indicator measurement provided by the participants.

After the analysis of the science content aspect done, the creative process of science comic construction can start. In general, the stage of the creative process consists of: writing the first outline of the comic, making the panels and storyboard, drawing the comic, reviewing by an expert, and revising the comic. The first outline of the story in this comic tells that there are the two-twin sibling that lived with their grandfather, who becomes a professor. They live happily with one robot named Payjo. Every science phenomenon that happens in their daily life always be asked by two sibling twins and Professor will ever explain it to their child. In this series of comic books, they were talking and told about the human digestive system so that the topic explanation that they are discussing is about

Table 3 Students' implementation rubric

No	Aspect	Indicator
1.	Legibility	I can understand the story, characters, and image easily
2.	Science Content	The story of each organ can be easy to understand.
3.	Characters	The characters of the comic give a strong personality to explain the story
4.	Image and Text	I can see the image and text balloon in the comic is related to each other
5.	Learning outcomes	I think comic gives learning more easy to understand
6.	Science Terms	The science term that used in the comics is understandable for me.
7.	Image to content	The comic gives me a natural picture to explain science concept more easily
8.	Ambiguous words	There are no difficulties for me to comprehend this comic (there are no ambiguous words)
9.	Expression character to the story	The expression and the text of the characters are related to the story
10.	Uniqueness	This comic is interesting and unique to read

human digestive system and its been added by some humour, culture, unique, and drawing style to make a proper sequence of comic.

After finishing drawing, some experts reviewed the comic by using the instrument rubric that consists of several indicators from the aspects (artwork, science content, languages, and uniqueness). The comic book revised according to the feedback and suggestion from the experts, to develop the final of the science comic book for the implementation test, two examples of comic pages developed shown in Figure 1.

2.3 Implementation Test

On the implementation test, participants are consists of three science teachers and three groups in 92 total of students in grade eight chosen from three different junior high schools in Bandung city area, Indonesia. After getting permission for implementation, the researcher starts to conduct the test at a different time because the location of the school is far from each other.

The implementation process is the same for three of the classroom. After the science comic book printed on papers given to the students, the students will be guided to read all the comic and directed to fill the questionnaire and implementation rubric test, the questionnaire and implementation rubric about the comic of the human digestive system listed in Table 2.

After answering the questionnaire, the students are directed to fill the implementation rubric test that consists of several aspects of measurement. The gradient measurement can see in Table 1. The indicator of each

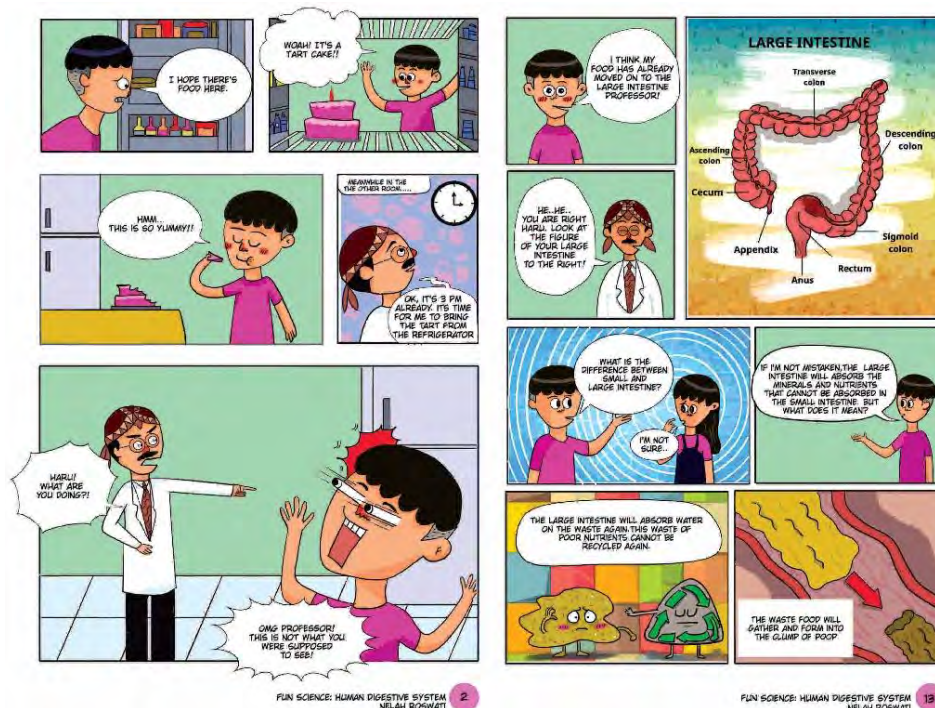


Figure 1 The example of two pages of the comic book developed in this study

aspect can see in Table 3. In addition to this study, the researcher also added the data of observation in class and the students' interview after implementation. The result data will analyze in the result session.

2.4 Data Analysis

In this research, there are several sources of data: judgment review from the experts, students and teacher implementation result, the written answer of students' questionnaire, observation during the implementation and students' interview. Because these data are in verbal form and patterns that may be qualitative feedback, they analyzed through qualitative content analysis. All data that have obtained, such as the review from the expert judgments, teachers-students implementation result, and written answer to the questionnaire, will be analyzed.

The participants, such as experts, teachers, and students, as the primary data of this research, were coded for some categories to draw a meaningful pattern and to obtain useful feedback for the development process of instructional science comics. The analysis of all data will be presented in percentage form before it shows in the table bar form for comparison and discussion results. The other data, such as researchers' observation and interviews, which are supplementary data of the study, were used to ensure the pattern in data from the questionnaire in the implementation process. In other words, the objective was to establish the validity of the results by using three different sources of the data.

The descriptive statistic will use as the analysis of data technique. In this study, quantitative analysis avoided because numeric results would not provide in-depth and

detailed feedback for the development process of instructional science comics.

3. RESULT AND DISCUSSION

3.1 Experts' Review to Science Comic Aspects

The result of experts' reviews divided into four aspects result. Each result was review and scored by the experts. The first is about the artwork aspect; this aspect consists of ten indicators related to the artwork things of the science comic. Experts review through the artwork aspect shows the positive value because each expert (coded by E1, E2, E3, and E4) gives positive feedback for each item indicator. The items that have a higher average score agreement of 90% are Image clear, characters, and cartooning humour. The item that has the medium score agreement of 80% is visualization item, and that have a lower score agreement of 70% are setting place or background item.

The result of the artwork shows more than 50% caused the characteristic of artwork that can be read by the readers. Besides that, the cartoon things that visualized in the comic can stimulate the active involvement of the students in the learning of science (Dalacosta, Kamariotaki-Paparrigopoulou, Palyvos, & Spyrellis. 2009)

The second one is the science content aspect. Experts review through science content items shows a positive value and feedback. The higher score agreement is 90% placed on concept appropriateness and visualizes learning items. The medium score agreement is 80% set on the specific example, learning experience, and thinking

triggering item. And the lower score agreement is 70% placed on the up-to-date item aspect.

The third is about the language aspect. Both English and Indonesian language from the expert feedback shows that the sense of humour aspect gets a higher score of 100% agreement Indonesian language and 93% agreement in English. The lower score gained by a grammatical structure that gets 73% in English and 60% in the Indonesian Language.

The last aspect is about uniqueness aspect. From five items, one item of culture aspect gets the lower score agreement, which is 70%. It indicates that the cultural aspect in this comic is not quite enough to be added, so this aspect should be changed or revised to gain more score. Besides the score, experts also give some comments and suggestions through this aspect.

Those aspects are commented on and suggested to gain a better result of science comics, especially for the humour aspect. The humour aspect has been proven to gain a good score of 100%. This humour aspect helps students to reduce tension in the classroom, relieving students' embarrassment, and increase their boredom (Ozdemir, 2017).

3.2 Teachers' Feedback Through Science Comic Aspect

The result of teachers' feedback also divided into four aspects. The first aspect is the artwork of the science comic. The higher score gained on cartooning humour, visualization, balloon dialogue, and setting place. The score agreement is 93%. This score indicates that those item has filled the expectation of the teacher through the comic artwork. The rest items gain lower rating, which is framing, image clear, story flow, perspective, characters, body movement, and text. The average score agreement increased was 87% from 100% ideal score. The second aspect is about science content. The higher score is 100% achieved by Learning experience items. The medium score earned by up-to-date and enjoyable learning items, which is an 87% score, and the lower score obtained by thinking triggering things, which is an 80% score from 100% ideal score.

The third aspect is about Language aspect. The higher score gained by understanding words, which is a 93% score. The medium score gained by word to expression, word to image, and scientific content dialogue, which is an 80% score. And the lower score gained by the grammatical structure, which is a 73% score from the ideal score agreement of 100%. The fourth aspect is about uniqueness. The data shows all item has the same score, which is 93% in all item of relatable, unique and new, enjoyable learning, sense of humour and culture. This score indicates the positive feedback from all science teachers

3.3 Students Responses through Science Comic

Students' responses through the science comic divided into two different data. The first is about the students'

implementation test. This test was allowing the student to give the score on each aspect in Table 3. The implementation test divided into four aspects, which are artwork, science content, language, and uniqueness.

The first aspect of the artwork shows that 59.7% of students reputed that the image and text of the comic are perfect. Besides that, there are 52.1% of students agree that the expression of and text of the character in the comic is related to the story. The second aspect of the science content aspect shows that 52.1% of students agree that the science content on the comic is useful to understand. Besides that, 43.4% of the students agree that the image is excellent to explain the science concept more easily.

The third aspect is the language aspect. There are 52.1% of students agree that the legibility of the story and character and image is excellent. Besides that, there are 42.3% choose that the scientific term used in the comic is proper. The last aspect of uniqueness shows that 60.8% of the students choose that the science comic is excellent, which is very interesting and unique to read.

The second is about the students' questionnaire results. Students' questionnaire results conducted to 92 students of year eight from different schools. The analysis answer has been scored based on the rubric of each question. The lower score gained by students BJ-F-54 and BJ-F-55 (Students code, BJ means classroom two, F means female gender, and 54 means the number of the student), which is 50 score. The highest score gained by student PN-M-03 (PN means classroom one, male gender, number three), and student BD-M-85 (BD means class three, male gender, number 85), which is 92 score. The average score gained from 92 students is 75.9 score.

After the average score already obtained, the comparison between how many students get the lower score and higher score from the average score can obtain. Figure 2 shows from the total number of students, which are 92 students, there are 40 students get the lower score from the average score, and there are 52 students get the top score from the average score. The result means the science comic can help the students to gain the average

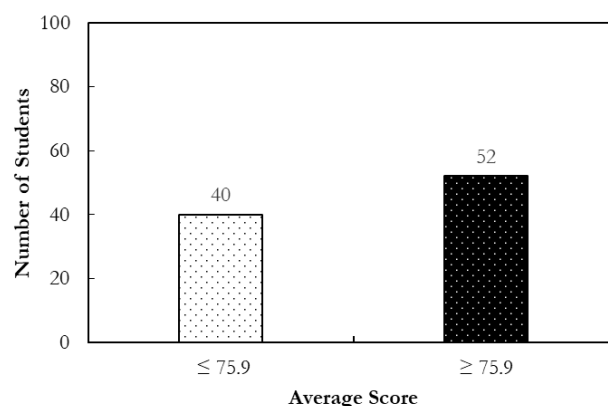


Figure 2 The comparison of students' average score

score and ease them to learn about the human digestive system.

Those results prove by direct interview and observation, and the students enjoyed learning science through the comic. Most of them are have fun with the relationship between visualization and science content. Moreover, more of them are like the humour aspect too. It indicates that humour can be the basis of attraction that leads to life-long participation in science.

3.4 Finding from Students' Observation and Interviews

The observation class divided into three classrooms, which are PN, BJ, and BD classroom. Each classroom treated the same, but the language the media used is different. PN classroom gives an English science comic book, and the rest classroom is an Indonesian language comic. All classrooms provide positive feedback and attitude, especially in classroom BJ. In this classroom, all student shows a conducive class environment different from the other.

Besides that, the interview also conducted in this study. The researcher focuses on the students who got a lower score (student BJ-F-55) in a questionnaire test, which is 50 score. The answer that she filled to the question was out of topic and different from the science concept given to the comic story. However, what makes the researcher pay attention to her result is, she gives an excellent score to the readability test, which means these students reputed that she can comprehend the comic. When the researcher asks this student, she is randomly giving the score and try to appreciate the researcher's hard work through the science comic made, when filling the questionnaire, she also cheated to her friend. This BJ-F-55 student said that she could not focus on reading the science comic because she dislikes reading books, magazines, comics, and other reading materials. So that she cannot comprehend the science comic better.

4. CONCLUSION

Based on the research result, there is some conclusion that can reach. Firstly, the step of making the science comic should following several steps such as curriculum content analysis, material source analysis, aspects measure analysis, and creating the storyboard and first outline to the creative drawing process. The drawing process can be categorized as an essential process because, in this step, the application of all plans will realize in the form of sequential art and narrative text.

Secondly, the experts' review toward science comic shows that all aspects consisted of the comic, which is of artwork, science content, language, and uniqueness aspect, mostly gain a good score, but it needs to be revised. The feedback that experts give also shows a positive value because most of them tried to give supportive feedback for science comic development.

Thirdly, the review from science teacher to all aspect measurement of science comic categorized as a good score. Science teachers agree that this science comic could give good learning outcomes and the new experience to the students for learning science. Science teachers mostly criticized the grammatical and content aspects of the comic. Science teachers suggest to revise some grammatical structure on the comic text and reduce some science concepts that are not suitable for the 8th-grade student.

Forth, most of the students agree that science comics could help them to comprehend the science content more quickly because they can enjoy the story and the knowledge with the addition of humour in the comic. This data can prove because there are more 50% of students get a higher score compared to the average score (75.9 scores) gained in the questionnaire session. Therefore, it concluded that developing science comics, which consist of some humourous figures and explicit narrative content, could bring some interest to the students in learning science.

The additional suggestion to improve the next research can make by focusing on what aspect that matters to the science comic. Those aspects will be contained and be a unique character for the science comic itself.

ACKNOWLEDGMENT

The authors acknowledge Mrs. Nuryani Y. Rustaman and Mr. Ikmanda Nugraha, who have given the best suggestion, support, and improving the quality of this research.

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