Development of science comics as information media

N Hamidah, A Pramadi, M Sholikha* and M Maspupah
Department of Biology Education, UIN Sunan Gunung Djati Bandung, Jl. AH. Nasution 105, Bandung 40614, West Java, Indonesia

*maratussholikha@uinsgd.ac.id

Abstract. Science comics is one of information media that promote science studies among professionals and children by pictures. The purpose of this study was to develop and produce science comics as a means of knowledge information. The development process of science comic was supported by drawing tablets, SAI Paint Tool and Photoshop applications to produce e-comics. The results of the validation values of the material, presentation, language, and comic graphics were 89.3 with a ‘very decent’ category. Science comics resulting from this development were deemed very appropriate for use as a medium of information.

1. Introduction
Institutions around the world are in a constant struggle to improve science communication. From calls for journal papers to be simpler and more accessible to encouraging scientists to take a more active role through community engagement, there is a drive to demystify and improve public understanding of and engagement with science [1]. One of the development of educational game tools (APE) that is used for information media in graphic form is comics. Furthermore according to Waluyanto [2] science comics are media that present science material in the form of illustrated stories so that they are interesting and easier to understand, more relaxed, and make students unsaturated in learning and learning more enjoyable. Nugraha [3] also states that science comics are an alternative medium for playing while learning. Providing a pleasant science learning experience.

Science comics is a form of cartoon that expresses the characters, and plays the story in a sequence that is closely related to the image, and designed to provide science jobs and studies to the readers [4]. However, in case of a broad science base, the only approach is to adopt a common-sense delivery, which is relevant regardless of research areas. Without humor, science comic strips would be worthless. Every field of human undertaking has an element of humor that can be exploited to popularize the particular field. Humor can be the basis of attraction that leads to a life-long participation in science [5]. The purpose of this study was to develop and produce science comics as a means of knowledge information.

2. Methods
The research method used is Research and Development. According to Sugiyono [6] research and development are research methods used to produce certain products and test the effectiveness of these products. The development process of science comic was supported by drawing tablets, SAI Paint Tool and Photoshop applications to produce e-comics.
The use of SAI Paint Tool Application in PenTab (figure 1) aims to reduce the use of paper in making science comics. The last step, draft of science comics needs a validation by some experts in science material and media as well as validation by sample of reader after designing. This validation intend to get a number of readers responses regarding science comics as a media of information.

3. Results and discussion

3.1. Designing science comics
One of the early preparations for the design phase is the making of a story line in form of text script. This story line will later be implemented into a story board (picture flow) through sequential sketches. The second stage is the making of characters in comics. Here are some animated characters contained in the comics:

Animation characters in figure 2 is made based on the taste and needs of the whole story in science comics.
Tools and materials that must be prepared in advance in designing comic story boards are Drawing Tablet or better known as PenTab (figure 3), SAI Paint Tool and Photoshop applications. Drawing tablets are used as a substitute for paper, so the process of drawing characters and story lines directly on the tool as a step in contributing to reduce the use of excess paper.

Then the next steps is the making of storyboard shading:

After shading the image is perfect and neat in figure 4, the image is given the appropriate color and visualization effects so the image looks real and alive. Note the differences in the image before and after the following visualization effects:

![Figure 4. Shading story board images.](image)

![Figure 5. Provision of visualization effects (right).](image)
Figure 5 shows the image before giving the visualization effects (left) and after the visualization effects to make it look alive (right). The last step is to provide a text box to enter the script into conversations in their respective order.

Figure 6. Provision of text space.

Figure 6 is the last step in developing science studies in a form of comics. The shape of text box (round or square) depends on the space of the image and its scripts.

3.2. Validation stage
The validation stage is the most process through. Some of these include expert validation and a three-time revision process to produce a final science comics.

| Name of Validator       | Component Score | Total | Criteria       |
|-------------------------|-----------------|-------|----------------|
| Science Material Expert | 28  19  12  30  | 89    | Very Decent    |
| Media Expert            | 25  18  15  28  | 86    | Very Decent    |
| Reader Validation       | 31  19  16  27  | 93    | Very Decent    |

Average Validation Value 89.33333333 Very Decent

Components: 1. Material; 2. Presentation; 3. Language; 4. Graphing.

Figure 7. Diagram of the validation results.

Technology and social media outlets like Twitter, Facebook, Instagram, and Tumblr have expanded the reach of science communication within and across scientific disciplines and to the lay public. These new communication channels seem to support endless innovations in the development of
videos, interactive quizzes, and instant feedback. Yet they are also providing a platform for a renaissance of one of the simplest and most effective methods for communicating ideas—comics [7]. Based on the results of the validation from the three experts (material, media and reader), the average number of scores obtained by the science comic is 89.3. So, the science comics as a result of this development research have been declared worthy with the "very decent" category [8].

An effective comic can communicate difficult ideas efficiently, illuminate obscure concepts, and create a metaphor that can be much more memorable than a straightforward description of the concept itself [9]. Some of the above studies at least prove that science comics can indeed and deserve to be taken into account as a medium of information. Several studies above prove that comic science as a medium of information is very well responded by experts and readers.

References
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