Journal of Physics: Conference Series

PAPER • **OPEN ACCESS**

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To cite this article: R Aisyah *et al* 2017 *J. Phys.: Conf. Ser.* **895** 012011

IOP Conf. Series: Journal of Physics: Conf. Series **895** (2017) 012011 doi:10.1088/1742-6596/895/1/012011

Learning Crude Oil by Using Scientific Literacy Comics

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Abstract. A research has been conducted to create a crude oil learning media in the form of scientific literacy- oriented comic. The research included some phases, namely: concept analysis, material transformation to concept map, indicator identification and science literacy aspect. The product was made based on flowcharts and storyboards that have been validated by expert validators. The product has characteristics namely; 1)Develops indicators and aspects of science literacy, 2) presents the materials in form of story of science fiction genre, 3) has characters adopting levels of scientific literacy, 4) has optional stories, because it depends on questions asked to develop scientific literacy in terms of content, context, process and attitude. Based on feasibility test, the product is feasible to be used as learning media. It is suggested to do an expanded experiment to examine its affectivity in improving scientific literacy and growing students' awareness about the issues of energy crisis and the impacts of fossil fuel use on the environment.

1. Introduction

Crude oil is one of learning material taught in senior high school. In addition to constructing students' knowledge, this learning material can be used to make them care more about the issues of fossil fuel supply and the impacts of using crude oil on the environment [1][2]. Scientific literacy is a skill to use scientific knowledge, identify scientific issues, explaining a phenomenon scientifically, and use scientific evidences in daily life [3]. This learning material includes scientific literacy aspects namely, scientific content, context, process and attitude [4]. However, the learning more emphasizes on understanding the concept than on developing scientific literacy [5]. Moreover, the books that students usually use are less attractive to read [6], so that it becomes the constraints to grow their scientific literacy in relation to crude oil issues.

Students are more likely to be interested in reading pectoral story (comic) rather than academic books [7]. Comic has systematical and orderly story that makes them easier to follow and memorize its content [8] so that they are interested in reading [9]. If designed correctly and appropriately, comic has pedagogic resources in learning [10]. The closing and the story in the comic can be written by carrying pedagogic issues stimulating students' creativity and activeness[11]. The content can be non-fiction and concepts and issues carried in the story can be written as attractive as possible[10][7].

This paper describes the development of design through research to produce a product in the form of a chemistry comic carrying crude oil learning material, oriented to develop students' scientific literacy toward the issues of energy crisis and the impacts of fossil fuel use on the environment.

2. Methodology

To create the product, scientific literacy comic on crude oil material, this research used design-based research method [12] [13]. The research included some phases, namely: concept analysis, material transformation to concept map, indicator identification and science literacy aspect. Then, flowcharts and storyboards were arranged as the basis for formulating ideas and stories. The flowchart consisted of the diagram of story plot to develop the plot of every page in the comic. The storyboard consisted of the sketch of pictures arranged systematically based on the planned plot of the comic story. Then, A validation was done by three three experts in the field of this study to review the quality of the comic, the appropriateness between the content and the plot of the story, the aspects of the display, and supporting elements. Based on the result of the validation done by the validators, there should be some improvements in terms of flowchart and storyboard that have been arranged. In addition, the material in the comic was made by using a software, Manga Studio version 5.0.

The product, a comic made in the form of a book, was then tested in relation to its feasibility to obtain an assessment regarding the aspect of learning, the easiness to learn the material, language, and graphics. The respondents in this feasibility test consisted of ten prospective chemistry teachers, two students and one chemistry teacher.

3. Result and Discussion

Based on analysis result toward crude oil concept, there are five sub-concepts, namely: The proses of crude oil formation, proses of crude oil processing, the product of crude oil processing in daily life, fossil fuel, and the impacts of the gases from burning fossil fuel. These five sub-concepts are abstract concepts, concrete example, and the concept based on process[14]. The aspects of content and context of crude oil material are presented in the form of the issues of crisis and energy conversion, crude oil processing, and the impact of fossil fuel on the environment. Furthermore, the aspect of scientific process is presented to develop thinking skill in relation to the process how a phenomenon can occur. As for the dialog in the comic, it is made to provide argumentative thinking that have an impact on the development of scientific attitude. The presentation of these four aspects of scientific literacy are made in a plot of story with pictures based on the character, informative dialog, and argumentative dialog as well.

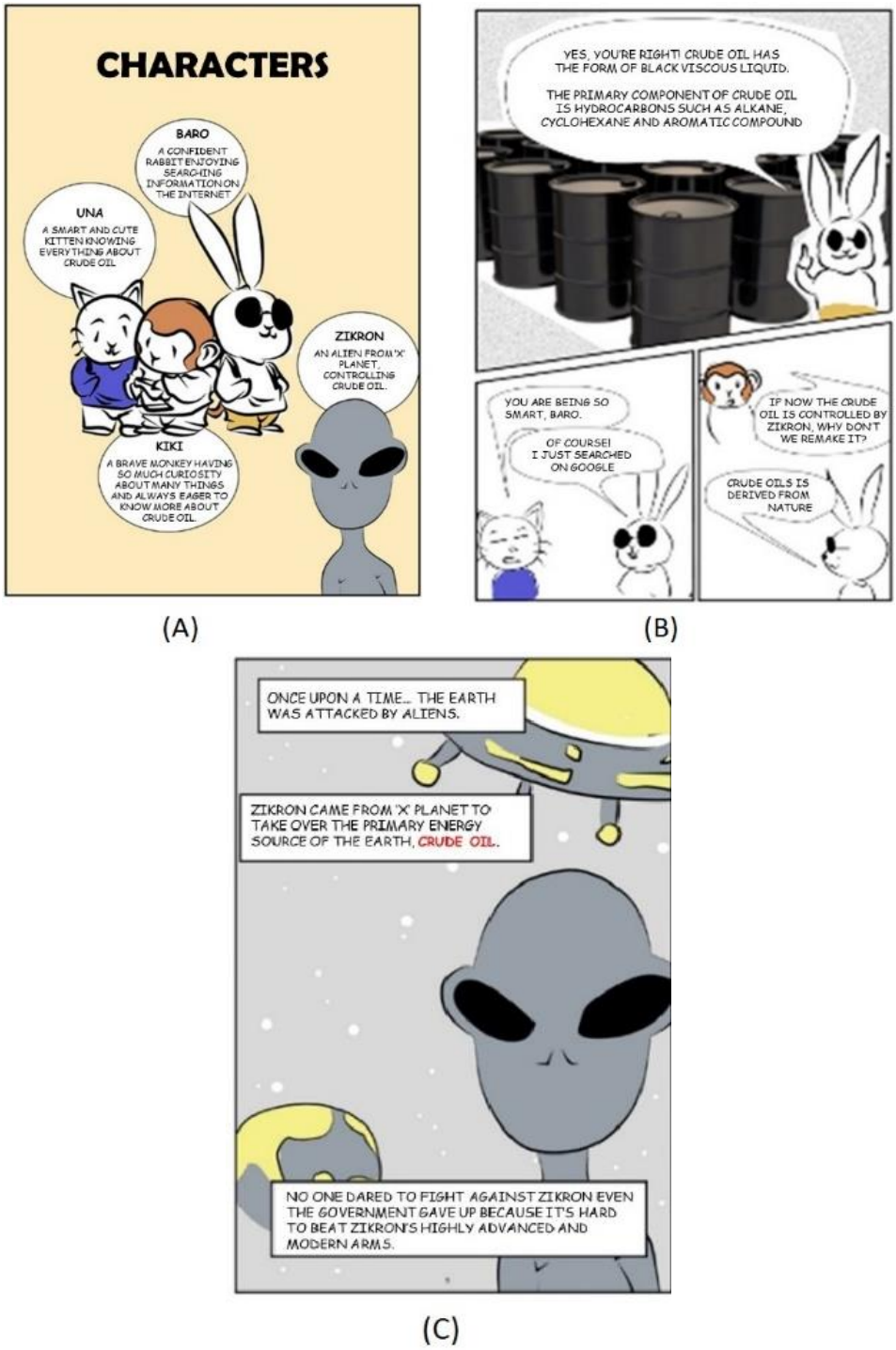

Figure 1. The Visualization of Comic characters

In general, the idea of the story in this comic is about scientific fiction and adventure. The comic tells about the efforts of a group of teenagers "Earth Ranger" to fight against an attracts from alien named Zirkon. Zirkon as the antagonist came from planet "X" and he wanted to take over earth's energy source, Crude Oil. The teenagers protecting the earth "Earth Ranger" consisted of three characters (picture 1A), namely Baro (rabbit), Una (cat) and Kiki (monkey). Each character represents the levels of scientific literacy, i.e. c*onceptual*, *multidimensional* and *functional scientific literacy* [15]. The use of these characters is for stimulating an attractive dialogue among the characters as we can see on

Figure 1B and 1C. Therefore, this comic is expected to fulfill the characteristics of scientific literacy-oriented comic [4][16].

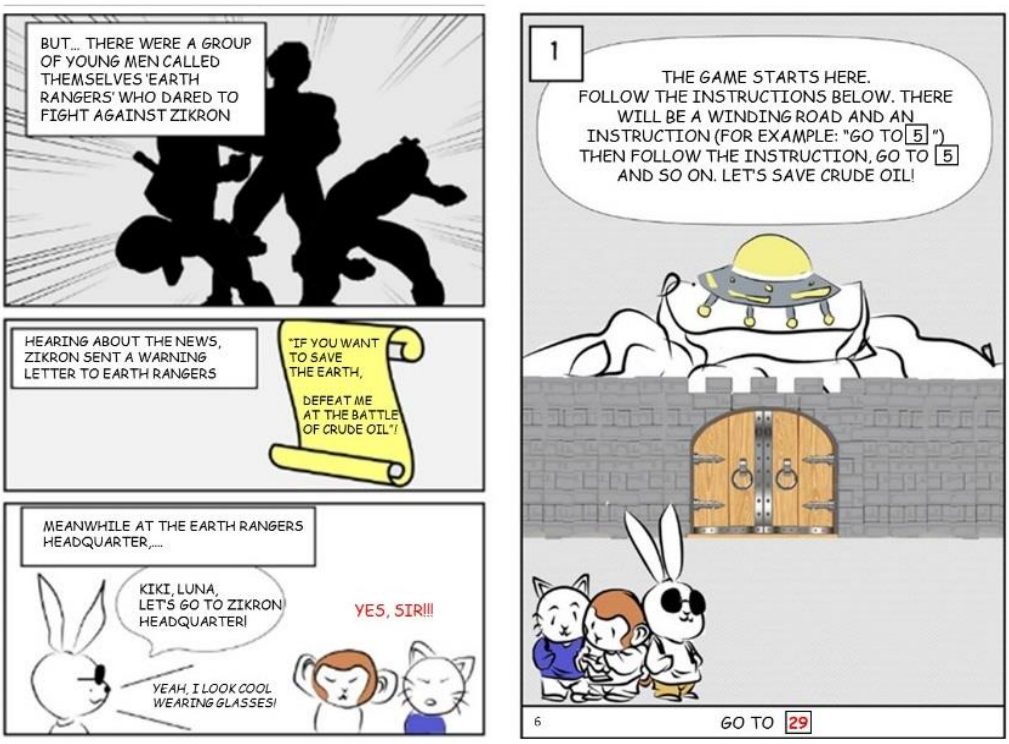

Figure 2. The example of the display of the content page in the comic

The development of scientific literacy aspects in the comic is made in the form of game capable of challenging readers' thinking capability and growing scientific attitude. In every page, there is half or one page full of pictures with the dialogues of the characters. The flow of the story facilitates the readers to choose their own flow, depending on their capability to answer the questions and challenges. If they are already sure that they already have the right answer, they will be lead to go to certain page or go back to the previous one. This strategy is adopted to encourage readers to think and develop their scientific literacy [10]. On figure 2, we can see the explanation in a page in crude oil comic

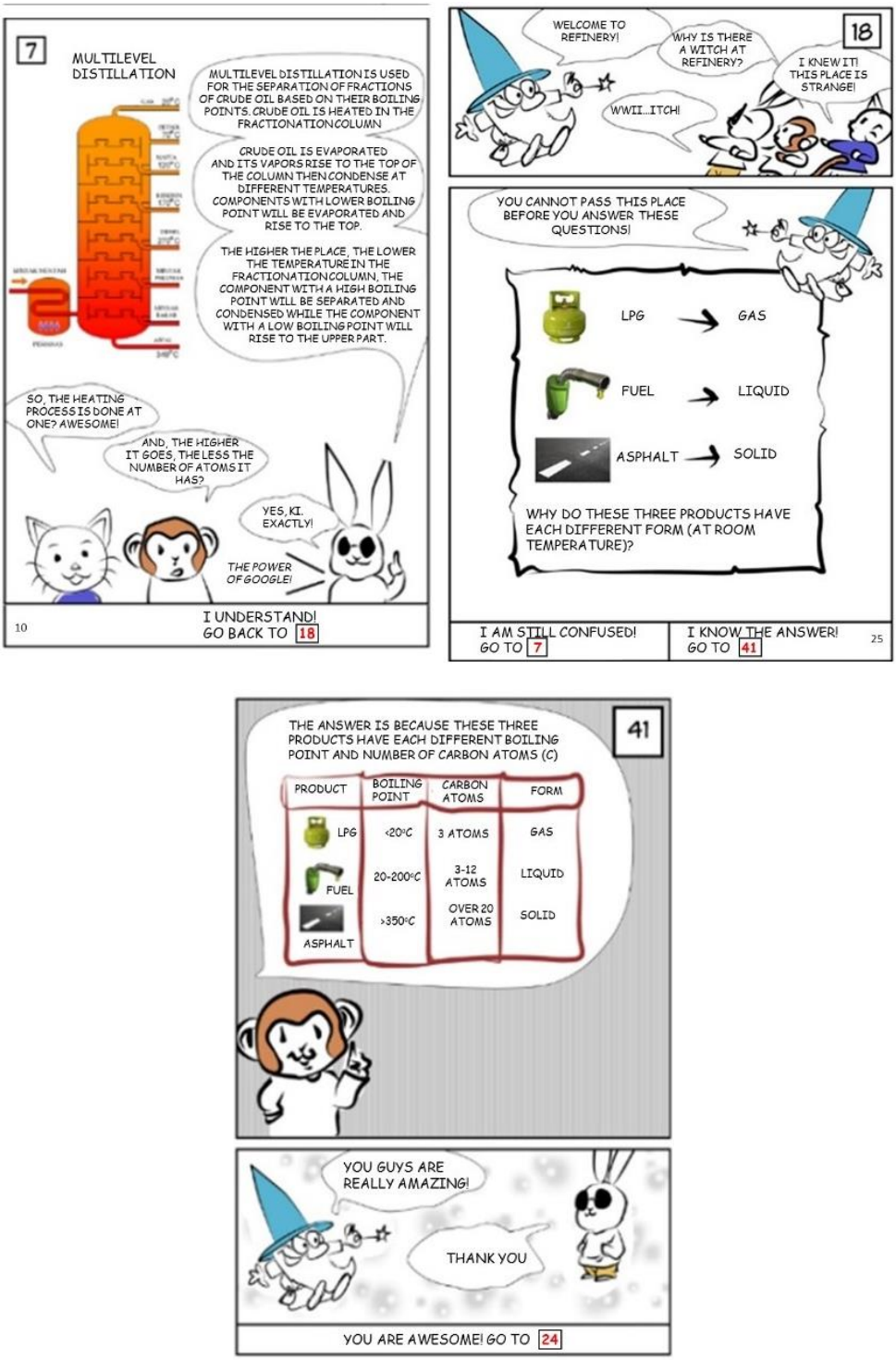

Figure 3. The example of the display of content and process aspect game page

Scientific content aspect is described by presenting the explanation of multilevel distillation in the process of crude oil processing. Scientific content consists of scientific concept required to understanding scientific phenomenon [3]. Scientific process is a skill to obtain knowledge according to scientific evidences and facts[3]. The example of the presentation of content and process aspect in the form of game classifies the products of crude oil processing based on their appearance and their length of carbon chain (figure 3). If the readers are already sure about their answer for the questions,

they can continue to the next page, but if they are not sure yet, they will be suggested to go back to the previous page.

It is expected that after learning this crude oil material, they will show positive attitude towards knowledge and be aware about the environment and the nature. The visualization of scientific attitude aspect can be seen on figure 4.

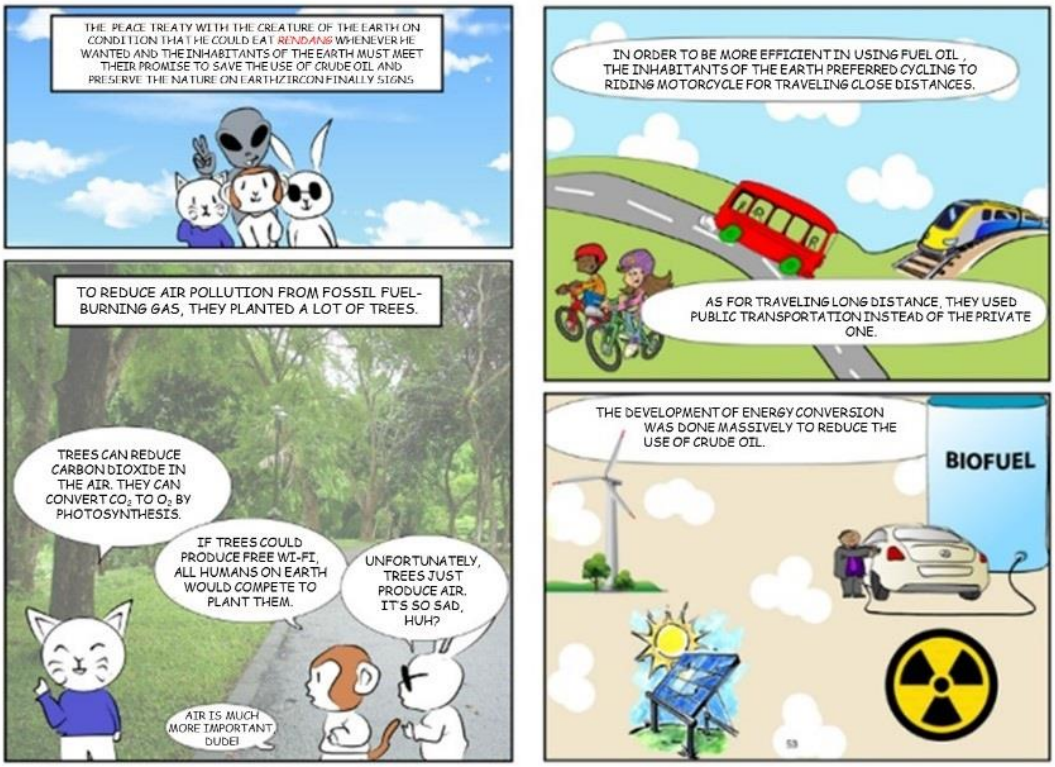

Figure 4. The Display of the page of scientific attitude aspect

According to the explanation above, comic learning media is made based on how students learn from picture and the use of graphic during studying [7][11][10]. The pictures and the flow of the story is arranged in order to make students able to interpret and memorize the text content written easier [9]. The flow of the story also deliver some messages that technology should have high adaptability and easy to operate by avoiding the impact on the environment [17].

The validated done to the content by the validators comes up with some advices for the improvement of the product, namely related to the clarity of the content in the dialog, the asking of questions and challenges that should be more focus on examining users' understanding about the content, and the graphics on certain pages. The result of feasibility test shows that 88 % of respondents agree that the questing asked in the game are highly relevant with the indicators of scientific literacy developed, 95 % of respondents agree that the sequence of the material is interesting and challenging, 90 % of respondents agree that the comic is useful for making the learning of the materials about crude oil easier and make them aware about the issues of energy crisis and the impacts of fossil fuel use on the environment. Based on this research results, our product still needs expanded experiment to examine its affectivity in improving scientific literacy, especially in terms of growing students' awareness about the issues of energy crisis and the impacts of fossil fuel use on the environment

4. Conclusion

Through design-based research, we have developed a learning product in the form of scientific literacy-oriented comic. The product has characteristics namely; 1)Develops indicators and aspects of

science literacy, 2) presents the materials in form of story of science fiction genre, 3) has characters adopting levels of scientific literacy, 4) has optional stories, because it depends on questions asked to develop scientific literacy in terms of content, context, process and attitude.

Based on validity and feasibility test, the product is feasible to be used as learning media. It is suggested to do a broader experiment to examine its affectivity in improving students' scientific literacy.

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