

The Development of Pop-up Book on the Role of Buffer in the Living Body

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Abstract

The aims of this research were to: (i) develop a *pop-up book* on the role of buffer in the living body for senior high school, and (ii) describe the response of learners and teachers to the developed pop-up book. The method of research was a Research and Development (R & D) with a model ADDIE (Analysis, Design, Development, Implementation and Evaluation). Phase of analysis was done by interviewed the teacher and distributed questionnaires to the needs analysis to 26 learners of senior high school, named SMAN 3 Banda Aceh. The design phase included the activities of the material formulation, the determination of media design (theme, colors and images) and manufactured of blueprints pop-up book that would be validated. The development phase was done by manufactured of pop-up book as designed and carried out feedback from the expert validators. At the implementation stage, the learning process was conducted using the developed pop-up book to study the response of learners and teachers on the book. In the evaluation phase, the successfulness of development of a pop-up book using ADDIE models was determined. Based on the results of the feasibility assessment of pop-up book, the responses of learners and teachers noted that pop-up book has been successfully developed with the average percentage of 94.047 percent and the feasibility of obtaining the category of very decent. The percentage of response' learners reached 92 percent and the percentage of chemistry teacher's response was found to be 80 percent. Obtaining this percentage was in excellent condition, so that it could be said that the students and the teacher to respond strongly agreed that the developed pop-up book could be accepted as an alternative medium of learning the material role of buffer solution in the living body.

Keywords: Pop-Up Book, ADDIE, and Response

Introduction

Background of Research

Reading the textbooks of chemistry by students can help learners to remember and understand the informations about the books. However, learners cannot fully develop its understanding of the concept. These constraints also supported by the abstract nature of chemistry, causing learners assume that chemistry is a difficult subject. In addition, the learning process tends to be serious and less fun further support this paradigm, resulting in reduced enthusiastic about learning and creates a feeling of saturation on the learner in the learning process. Based on interviews with one of the chemistry teachers of senior high school, called SMAN 3 Banda Aceh, it has been known that teachers used lecture and group work in the learning process. However, this study was less effective in providing an understanding of material, especially for the role

of buffer in the living body. This is evidenced by the value of the minimum classical completeness (KKM) learners who despite being relatively well (84.375 percent), but still cause dissatisfaction because the average student only able to reach the KKM was 75. According to Sanjaya, (2012) knowledge will be abstract if only communicated verbally. This resulted in reduced arousal learners to capture the material, because they are not encouraged to think and live up to the material presented. Learners need to be involved both physically and psychologically in order to understand the material.

Based on the above problems, then do a print-based media development of a unique, able to provide a learning atmosphere is fun, exciting and easy to understand their enthusiasm in order to optimize the learning process chemistry. According Arsyad, (2010) the use of instructional media can help alleviate boredom and stimulate learners to learn and eventually were able to improve the achievement of learning objectives.

One of the innovative media to engage learners is a pop-up book. Pop-up book is a book that can display images with three-dimensional effect arises when the book is opened and provide a unique stir effect when pulled on some parts. According Khotimah, (2012), a unique visualization of pop-up book in the exposure of the material to stimulate learners to learn, develop capacity, and facilitate learners to remember the material in the book. In addition to the uses described above, the reason for selecting the pop-up book as a medium that will be developed is because learning to use the pop-up book on the role of buffer in the living body has never been done.

Several studies have shown positive results against the application of pop-up book in the learning process. Study done by Jannah, (2015) about the development of instructional media pop-up book about virus material for class X SMA concluded that the value of the final test learners classically increased after the implementation of *pop-up book*. Learners and teachers provide a fairly good response on the application's pop-up book. In addition, the level of learning activity was very active which amounted to be 93.33 percent. Febrianto, *et al.*, (2014) adds that the application of a pop-up book on learning the elements of such a show increased enthusiasm of learners in the learning process.

Based on the description that has been described above, therefore this research was done.

Research methods

The approach used in this study was a qualitative approach. The type of research was Research and Development (R & D) using ADDIE models, namely: (1) analysis, (2) design, (3) Development, (4) implementation, and (5) Evaluation. The experiment was conducted in senior high school SMA Negeri 3 Banda Aceh, located at Jalan TGK. H. Mohd. Daud Beureueh No. 454 Banda Aceh. The research was done in class XII Science 4 the 1st half of 2016/2017 academic year in July 2016 to December 2016. The subject of this research was the students of class XII-MIA 4 SMA Negeri 3 Banda Aceh, amounting to 26 people, which was 10 sons and 16 daughters with two chemistry teachers. MIA XII class subject selection done by random sampling.

Research Instruments & Data Collection Techniques

The research instrument used in this study were:

- 1) Questionnaire of needs analysis were completed by learners, has eight (8) statements that aimed to obtain information about some of the problems that exist in the learning process.
- 2) Feasibility assessment sheet of pop-up book was filled by two expert's validators. This assessment form was intended to find the feasibility of developed pop-up book.
- 3) Questionnaire of learners' responses was contained eight (8) statements related to the interest in the pop-up book, in terms of general, benefits, language, display, and use of the developed pop-up book.
- 4) Questionnaire of teachers' responses had 10 (ten) statements related to the interest of teachers to the *pop-up book* in general, benefits, language, display, and use *the pop-up book*.

Data analysis technique

The feasibility analysis of pop-up book aimed to measure the quality of design of the pop-up book, in terms of media visualization format, content and language. In addition, to assessing the feasibility of a pop-up book, did an analysis of the response data of teachers and learners after application of the pop-up book in the learning process. Criteria for assessment of the feasibility of the media and the response was also expressed in percentages. Table 1 shows the percentage score media and eligibility assessment or reponse (Arikunto & Jabar, 2010).

Table 1. Percentage Score Media and Eligibility Assessment or Response

No.	Value (%)	Qualification (Eligibility and or Response)
1	80-100	Very Decent / Very Good
2	66-79	Decent / Good
3	56-65	Pretty Decent / Adequate Good
4	46-55	Less Worth / Less Good
5	0-45	Unsuitable / Very Poor

Results and Discussion

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1. Analysis

This activity was done by means of field studies for the implementation of the field experience program at the end of 2015 year. Interview was conducted to teacher of high school chemistry SMAN 3 Banda Aceh and also by distributed questionnaires to students' needs analysis. Based on interviews, the information was obtained that the media learned was not often used in the learning process. Teachers claimed that it was not satisfied with the study of students in the material buffer because there were many learners who were only able to reach the KKM (value 75).

The results of the analysis of the needs of learners' class XII MIA 4 still had not fully demonstrated in motivation to learn independently by reading printed books. The printed books which were less attractive to be one reason for the overall students (26 people) preferred to learn in a way taught by a teacher than reading a physical book itself. In fact, learning was taught by teachers demanding learners to remain independent learning through reading activities in order to better understand the material being taught. The unique of pop-up book was raised the desire of students to read and learn independently, so that students no longer made the teacher as the main source of information acquisition in learning and they were better able to understand the material that would be taught by teacher. This was in accordance with Jannah, (2015) which stated that the pop-up book had the benefit of love of reading among students.

In addition, a total of 84.61 percent of students considered that chemistry was a difficult subject. The greatest difficulties for learners was to imagine the logic/processes that occur in chemistry. The presentation of the pop-up was very unique, it could be facilitated learners in understanding and remembering process by the body's defense pH stability buffer solution. It might be due to the pop-up book had the ability to reinforce the message that would be delivered (Khotimah, 2012). Three-dimensional shape when the pleats were opened and accompanied by the movement of components of the image would affected the interest of learners to keep open a pop-up book (Ifadhah, 2015). The interest of students to study chemistry could be raised and students could be understood the material. They also believed that the chemistry was not as difficult as imagined before, so it could be said that the pop-up book could helped to overcome the difficulties of learners.

The results of the needs analysis also found that 95.45 percent of students wanted to learning process in a fun atmosphere. The use of pop-up book to create a learning atmosphere that was quite enjoyable as required by learners, so

that the spirit of learners could be maintained. Bluemel and Taylor, (2012) stated that the pop-up book readers would felt reading was fun and would gave rise to a desire to keep learning.

The use of instructional media could affected the learning environment became more enjoyable. However, the media was still not too often used in the chemistry learning in SMA Negeri 3 Banda Aceh. It was due to the small variations in the choice of media by teachers, especially for materials the role of a buffer solution in the living body. So that the pop-up book was needed to be developed in an effort to increase the choice of media that could be used in the material. A total of 95.45 percent of students had never learned to use a pop-up book. They felt to be attracted to pop-up book that was new and agreed that the application of the pop-up book was able to generate the motivation to learn. Mariani, *et al.*, (2014) stated that the process of learning to use a matematics pop-up book was able to generate enthusiasm learners in learning. This enthusiasm arised as evidence of motivation for learners, so the pop-up book could be used to motivate learning on the learner. The motivation of learners from the pop-up book could ultimately had a positive influence on the delivery of the material, thereby enabling obtainment better learning outcomes.

Based on the overall results of the needs analysis of learners, therefore the development of pop-up books had been selected as one of the efforts to address the problem and met the learning needs of material on the role of a buffer solution in the living body. The development of a new media that was unique and interesting as a pop-up book was able to increase the variety of media options of learning for teachers.

2. Design

The design stage in the creation of media involved three steps:

a. Formulating the Materials

The materials were created based on the syllabus, basic competencies, core competencies and goals. In this step, literature study was done to collect informations related to the role of buffer material in the living body through a variety of high school chemistry textbooks and university chemistry books. Results of information in gathering material, collected and a simplified discussion of using language that was more easily understood by learners.

b. Determining the Media Design

Media was designed by drafting a set of learning materials which was obtained sequentially according to the indicators and search for images, themes and basic colors of developed pop-up book. Bluemel and Taylor, (2012) stated that one of the criteria to be considered in the format design of the pop-up book was the character creation (image) and color selection. Overall, the image obtained through the website freepik.com, a provider of website icons, vector, photographs, illustrations and PSD files used by graphic designers. After the process of looking for, it was determined that the color theme and basic books pop-up book was blue with a picture of the character of a teacher who was teaching.

c. Creating a Media Plan

After preparation of the material, the pictures were looked for. The theme of pop-up book was defined. The next step was to draft this media using CorelDraw software X7. Drafting this media was refered to the six elements. The elements those needed to be considered in the development of print-based text was proposed by Arsyad, (2010). There were consistency, format, organization, magnetism, font size and empty space. The activities carried out in this media plan step were included the collecting, preparing and designing the layout of the image exposure of the material as possible to the role of a buffer solution in the living body. Figure 1 shows the results of the design of the pop-up book on the material role of the buffer solution in the living body.

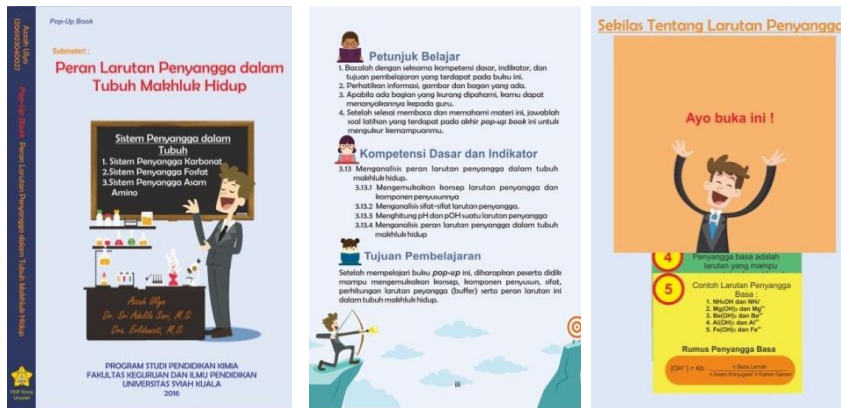


Figure 1. The Design of Pop Up Book

3. Development

The development phase included the manufacture of pop-up book as designed and carried out revision as feedback from the expert validators. The printed design and translated into a pop-up book with a size of 20.8 cm x 15 cm x 1.5 cm which had 15 pages, namely:

- The bottom of the book, printed using construct paper that had been laminated, then attached to the cardboard twice (for the front and back covers of hard cover) and 260 grams of ICT paper which was also laminated (for sheet contents of the book). The use of paper with a weight of 260 grams made loud pop-up book, good and not easily damaged. White portions contained in the basic pop-up book served as an adhesive landmark for material.
- Part book with pop-up techniques were printed using inkjet matte paper 220 grams. A good paper for a pop-up book must have weighed in on HVS. So that pop-up was nice and easy in manufacturing process (Jannah, 2015). Once part of the pop-up technique was printed, the next stages were of cut, glued, folded and stringed and pasted it at the bottom of the book. The accuracy must be required when glued with the right proportions so that the pop-up technique could be moved well (Klein, *et al.*, 2015). The techniques used on the pop-up book were parallelogram, waterfall, flap, pull tabs, double slider, and v-fold those can be seen in Figure 2.

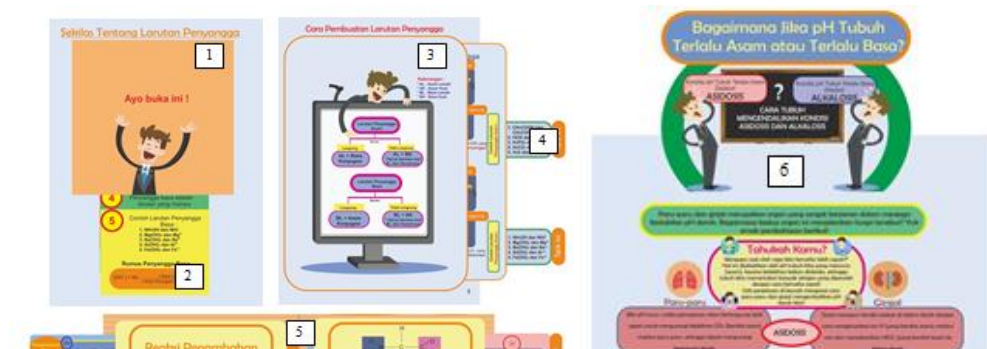


Figure 2. The techniques used pop-ups the book: 1) parallelogram, 2) waterfall, 3) flap, 4) pull tab, 5) double slider, and 6) v-fold

After going through the manufacturing process, according to the expert validator, a pop-up book that has been completed still required some revisions. Therefore, it was required further development stage in order to be a viable media used in the learning process. Some of the improvements to be made on the pop-up book by experts validator, such as: 1) on page 2, a pop-up book section told you how to manufacture buffer and page 5 of the pop-up book elucidation hemoglobin should be enlarged images and writings in order to more clearly readable by learners when working in groups. Smaldino, *et al.*, (2012) stated that in making media, the format was considered to be suitability of media with teaching situations and circumstances (for example, large groups or small groups). Images and the texts of pop-up book that were not suitable for teaching small groups of 4-5 people with learners, so it should be improved by increasing the image and the text, 2) on page 14, the pop-up book section exercises number one, said "functions" should be replaced with the word "role" to conform to the language used in the book's title.

When the revised pop up had been finished, then the book was reprinted and redeveloped into a teaching material and ready to be implemented in the learning process of students of class XII MIA 4 SMA Negeri 3 Banda Aceh. The developed pop-up book was obtained the category of very decent in terms of media presentation, content and language used. The percentages were found to be 94.45 percent for media presentation, 90.63 percent for the material aspect, and 100 percent for aspects of language, respectively. The average value of the percentage of the feasibility of a pop-up book amounted to 94.047 percent.

In addition to validate the feasibility of a pop-up book, questionnaire responses of learners and teachers were also validated by two expert validators. Questionnaire to be used could be declared in valid if it had a value of validity of more than 60 percent (Zeila, *et al.*, 2014). Validation of questionnaire responses of learners earned a percentage of 100 percent and validation of responses questionnaire of teacher got a percentage of 93.3 percent. Based on the percentage value, it could be stated that both questionnaires were valid and could be used to obtain the data on the response of the students and teachers.

4. Implementation

Once the entire questionnaire and a pop-up book had been declared in valid, then the next step was to use the developed pop-up book in the learning process in order to know how the responses of learners and teachers on it. This implementation was performed during one session (2x45 minutes) by applying the method of group work. Learners were divided into six groups, each group consisted of 4 or 5 people. The group division was done randomly, tailored to the group that had been set by the XII grade chemistry teacher MIA 4. Overall learners who had been sit in a group then obtained the brain storm, presented the material classically for 15 minutes and information on how to use the pop-up book at the beginning of learning. Learners were closed attention to the explanation given on the role of a buffer solution in the living body using a pop-up book. Febrianto, *et al.*, (2014) stated that the pop-up book was used to attract the attention and learners' focus on the explanation, so that the material presented by the teacher could be captured optimally.

After that, students were given some times to read and answer questions on a pop-up book and students' worksheets (LKPD) together with members of the group for 45 minutes. Learners were observed very enthusiastically in the task group that used the pop-up book. This observation was consistent with research done by Mariani, *et al.*, (2014) which found that the use of pop-up book of mathematics in groups in the learning process could helped students more enthusiastic in learning.

During the learning process, a pop-up book was proved able to maintain the motivation of learners. This was shown by the attitude of learners who were seemingly happy, uplifted and very at home reading books pop up while working on a joint task group members, from the beginning until the end of the learning process. So that the group task could be completed quite well. According Noviyanti, *et al.*, (2013) motivation was arised on learning activities using the pop-up book due to this pop-up book was a new thing that was very interested for students. Therefore, as to generate curiosity that ultimately made the learners were able to master the material. After the students completed the task group, pop-up book and LKPD were

reassembled and then responses questionnaire was distributed for 26 (twenty six) learners MIA XII class 4 and 2 (two) chemistry teachers from SMA Negeri 3 Banda Aceh.

5. Evaluation

This evaluation phase was conducted to determine the successful development of a pop-up book using ADDIE models. Based on the results of the validation performed by the validator of experts, the feasibility of a pop-up book was received the category of 'very worthy'. It has been known that the pop-up book on buffer role in the living body has been successfully developed. This statement was supported by the students and teachers who responded very well to the application of the pop-up book in the learning process.

Responses

1. Response of Students

Learners gave a pretty good response for each item statement. Those interested in the pop-up book for use books was a new thing in the learning process and different from other learning media. It looked quite interesting also affected the learning environment became more enjoyable. Learners agreed that learning to use a pop-up book was found to be increased the motivation, very unique and the presentation of the material was easy to be understood. From the questionnaire, it was well known that the developed pop-up book was quite clear with the sentence that was easily understood about the material. The pictures, writings and material contained on the pop-up book in accordance with the school handbook, even some learners found the material on the pop-up book was more complete than the school handbook. Learner was agreed that if the media pop-up book was used as an alternative media in understanding the chemistry learning, even they also wished to use a pop-up book for the other subjects. The recapitulation of the percentage of each item statement learner's responses can be seen in Table 1.

Table 1. Summary of Students' Responses

No.	Statements	Total	%	Category
1.	<i>Using the pop-up book in learning is very interesting</i>	3,73	93.25	Very good
2.	More pleasant learning atmosphere when using pop-up book	3,69	92.25	Very good
3.	Pop-up book can improve my learning motivation	3,65	91.25	Very good
4.	Pop-up book can facilitate my learning	3,73	93.25	Very good
5.	Sentence/grammar in pop-up book is easy to understand	3,61	90.25	Very good
6.	Materials in pop up book is in accordance with the books that used in school The developed pop-up book is easy to use	3,61	90.25	Very good
7.	I agree that pop-up book can be an alternative in understanding chemistry	3,69	92.25	Very good
8.		3,73	93.25	Very good
Average		3,68	92	Very good

In general, the acquisition of the average percentage of the questionnaire responses of learners by 92 percent with the criteria very well. This response illustrated that the developed pop-up book could be accepted and eligible for use in the learning process on the role of buffer material in the living body.

2. Teachers' Responses

Teachers were very interested in using the developed pop-up, as a pop-up book relatively new media that was able to attracted attention in learning and increased the motivation of learners to read and learn. The presentation of the material that was easy to understand, visual displayed pop-up was unique, interesting and not monotonous able to reduce the saturation of learners in learning. The learning environment became more fun for the students to play while learning. Learners became curious on some hidden parts pop-up techniques, thus indirectly would be generated curiosity in learners. According Noviyanti, *et al.*, (2013) in addition to facilitate students in learning, the use of pop-up books could also be easier for the teacher to explain the material and manage classes.

Overall, percentage statement obtained a good response, except the statement number 5 (five) that had a poor response categories. Teachers gave a little advice to replace the technical part of the pop-up with the paper material was harder, so that was not easily torn or damaged if used repeatedly by learners in the future. Obtaining the average percentage of response's teachers by 80 percent with the criteria very well, fit for used and can be accepted as a medium of learning the role of buffer material in the living body.

Table 2 Summary of Questionnaire Responses Teacher

No.	Statements	Total	%	Category
1.	<i>I am interested using the developed pop-up</i>	3,5	87.5	Very good
2.	Pop-up book can create a fun learning	3	75	Good
3.	Student's activities were increased during learning using pop-up	3	75	Good
4.	Pop-up book can increase the learner's motivation	3	75	Good
5.	Pop-up book Media can facilitate students in learning and improving their understanding of the concept of this material	2,5	62.5	Enough
6.	The material contained on the media <i>Pop-up Book</i> is in conformity with the KI, KD, learning objectives and the concept of the real lessons Sentences/grammar on pop-up are good and easy to understand	3,5	87.5	Very good
7.	Displays (designs, drawings, paper type and size) of media <i>pop-up book</i> is good and interesting	3	75	Good
8.	Pop-up book is easy to use	3,5	87.5	Very good
9.	Pop-up book is suitable as an alternative learning media in understanding	3,5	87.5	Very good
10.	the role of buffer material in the living body	3,5	87.5	Very good
Average			80	Very good

In general, responses of students and teachers to the developed pop-up book were excellent amounting to 92 and 80 percents, respectively. The results showed that students and teachers were strongly agreed that the developed pop-up book on the role of buffer in the living body could be accepted as one of the alternative medium of learning.

Conclusions

Based on the research, some conclusions were drawn as follows:

1. The pop-up book on the role of buffer in the living body was successfully developed using ADDIE model and it was fitted for use with a percentage of 94.047 percent.
2. The responses of students to the developed pop-up book also were earned a percentage of 92 percent with a very good category. Pop-up book was interested for learners, more fun learning, be able to increase reading fluency, ease in learning, and language was easily to be understood. Therefore, the developed pop-up could be accepted as an alternative medium in the learning process.
3. Teachers' responses to the developed pop-up were classified as very good by 80 percent. Teachers were interested in using the pop-up book because it could be created a fun learning environment, improved the motivation and understood of the concept of learners, good grammar used and easy to understood, the displays were quite nice and interested, and allowed teachers to explain the material and managed the classes .

Suggestion

Based on the results of the reserach and its conclusion, the suggestions could be given as follows:

1. The techniques in pop-up book should be more varied so that the pop-up book was generated more interesting.
2. The paper materials for pop-up book should be harder to be long lasting and were not easily broken.

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