Increasing analytical thinking skills through a popup booklet development with digestive system

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Abstract. Lack of students' analytical thinking skills are caused by a lack of stimulation for thinking analysis. Learning tool is a means that can be used to stimulate students' analytical thinking skills. Booklet is a learning tool that can be developed with variations in design and content. Research on the development of a pop up booklet with digestive system has been applied to improve analytical thinking skills of 11th students at MA AskhabulKahfi. Procedure of development research employs the 4-Dmethod of Thiagarajan. The instruments are in the form of interview, observation, and questions sheets. Test results from both classes are processed using the t-test. The average percentage of assessment from material experts is 89.56%, and media experts up to 87.40%. The average post-test results of the control class are 51, and the experimental class is 68.6. The results of students’ responses in small classes up to 77%, while in large classes up to 80%. To compare the average post-test results in both classes, the researchers use the t-test. Based on the t-test, tcount>ttable, the average post-test of experimental class is higher than the control class. So pop up booklets are considered effective to improve students' analytical thinking skills.

1. Introduction
Lack of students' analytical thinking skills can be caused by a lack of stimulation for thinking analysis during learning. Stimulation for thinking analysis can be given during teaching and learning activities in the classroom. These stimuli, including learning tool and learning methods. The use of learning tool that is less varied can have an impact on lack of students’ analytical thinking skills.

Learning tool is a tool that carries messages or information aimed at instructional or containing teaching purposes [1]. Based on this statement, the use of appropriate learning tool can stimulate students’ analytical thinking skills. The use of learning tool can help in visualizing abstract material, so that the learning process will run better. This will affect students’ analytical thinking skills.
Learning tool can be in the form of print, audio visual based learning tool, computer-based learning tool, and learning tool in the form of teaching aids. Print learning tool is also called visual tool, this tool is like posters and books. Printed technology is a way to produce or deliver material, such as books and static visual material, especially through mechanical or photographic printing processes [2].

Audio-visual based learning tool is a learning tool that displays images and makes sounds, such as learning videos. Audio-visual teaching is clearly characterized by the use of hardware during the learning process, such as film projector machines, tape recorders, and wide visual projectors [3]. Thus, the use of visual-based tool requires a lot of tools.

Computer-based technology is a way to produce or deliver material using microprocessor-based sources [4]. The use of websites as tool is an example of computer-based learning tool. The use of websites as learning tool cannot be applied throughout the school, because not all schools have computer facilities for each student.

Learning tool in the form of teaching aids including Molecuk up tool types. Moleck-up, is a model of an object that emphasizes certain parts of an original object and removes other parts with the intention of eliminating the attention of students [5]. Examples of moleck-up tool are torso or props. Torso is an imitation of the original object, such as props for the stomach, skin, lungs.

The use of torso will be able to assist the teacher in explaining organ system material. Other tools that can be used are both 2-dimensional and 3-dimensional image tool. Picture tool is included in an image representation such as a painting or photo that shows how one thing seems [6]. The use of appropriate tool can improve students' analytical thinking skills.

Booklet is one type of graphic tool in the form of a picture/photo tool. The Booklet is a small (half quarto) and thin book, not more than 30 sheets back and forth containing writings and pictures [7]. Basically booklets can be said to be several leaflets that are put together and bound. The tool booklet that will be developed presents images of the digestive organs in 2 dimensions and attractive colors aiming to stimulate students' ability to think analytically. Students are expected to be more able to hone thinking skills analyzing through booklet tool.

Pop-Up is a book that has parts, it can move or have 3-dimensional elements and provides an interesting visualization of stories, starting from the appearance of images that can move when the page is opened [8]. The development of pop up booklets provides innovations in booklets that have previously been developed by students. The Pop Up Booklet is designed in such a way that students can be interested in learning it. The combination of elements of the art of paper folding with design art is expected to produce interesting and innovative booklets. The use of booklets accompanied by Pop Up will be able to assist students in understanding the material of the digestive organ system.

In addition to the use of tool, the method used by a teacher in delivering material is also influential. Material and methods are two sides of a coin that cannot be separated [9]. Both are important to learn and practice, so that learning runs effectively and have high quality. Therefore the use of tool and methods must be adjusted to the material to be taught.

The use of learning booklets as learning tool will help the teacher explain the digestive system material. Learning booklets are arranged more innovatively, given the 2-dimensional effect on the booklet. Provision of 2-dimensional effects with images - pictures of the constituent organs of the digestive system that can be opened. The existence of innovation in learning booklets is expected that learning activities that occur in class will become more interesting and students will become active.

Piaget (in Wadswoorth: 1984) explains that during the formal operation stage that occurs around the age of 11-15 years, a child experiences the development of reasoning and thinking ability to solve the problems he faces based on direct experience [10]. The ability to think analytically is one of the higher-order thinking skills that must be mastered by high school students. The use of booklets for digestive system material is expected to improve students' thinking skills, especially the ability of students to analyze. Students will be able to reason and think about the system because the use of this tool will be used sequentially and facilitate students in understanding the system.

Teaching and learning activities at MA Askhabul Kahfi went well, but for facilities that are still lacking. This is because MA Askhabul Kahfi has just been established so it still carries out physical
development in various buildings such as laboratories. The ability to think analytically of MA Akhabul Kahfi students in one class is only a few good ones. This is due to the lack of learning tool, teaching and learning activities that are at the end of class hours, the character of students who are often sleepy. Therefore, it is expected that using the pop up booklet can improve the analytical thinking skills of MA Askhabul Kahfi students.

Research on previous pop up was carried out by Ikshania Nikmatul Jannah (2015), the research conducted by taking viral material, and only in the form of pop ups had not been presented in the form of booklets. Other previous research conducted by Guni Gustaning (2014) on booklets as learning tool, but the material taken is the basic ability to draw pants. Therefore the author wants to make an innovation that combines booklets with pop up.

Based on the background of the problem, there will be development in the field of learning tool. The learning tool developed is the provision of innovations in the booklet in which a pop up image is given. The use of the booklet is expected to be able to make the teaching and learning process in the classroom run exciting. Therefore the writer will make a development of learning tool entitled “Increasing analytical thinking skills through a pop up booklet development with digestive system”

2. Research Methods
The research method used is research and development methods. This development research refers to the research model developed by Thiagrajan, Semmel, and Semmel (1974), namely the 4-D model. This model consists of 4 stages of development namely define, design, develop, and disseminate.

The development procedure in this study follows the 4-D model from Thiagrajan, which has been translated by Sani, et al, namely define, design, develop, and disseminate. The purpose of the define stage is in the form of literature studies and field surveys. At this stage include 5 main steps, namely: Front and Analysis, Student Analysis, Task Analysis, Concept Analysis, and Formulating Objectives.

The purpose of the Design stage is to make a draft of a digestive system learning booklet. This development phase is to produce the preparation of a digestive system learning booklet that is able to improve students’ thinking skills in analyzing the students in the previous stages. Activities at this stage include 2 steps, namely: Expert Validation, and Small Scale Trial.

The Disseminate phase is a phase to promote products to be accepted by users. This stage is carried out by testing the effectiveness of the resulting booklet. Activities at this stage are: large scale tests. Tests on large-scale trials were conducted to test the effectiveness of booklets as learning tool.

The instruments used in this study are: interview grids, observation sheets, questionnaires, and questions. Data obtained from material experts, tool experts, and student responses were calculated in percentage. Test results from both classes were processed using the t-test. T test is used to compare the average learning outcomes of the control class and the experimental class.

3. Results And Discussion Of Results
3.1 Results
This development research is based on observations at school, analysis of student needs, and analysis of teacher needs produced products in the form of a Pop Up Booklet for digestive system material. The Pop Up Booklet serves to improve students’ analytical thinking skills. This learning booklet is used as a learning tool to replace posters or props of the digestive system organs.

The initial stage is to define, at this stage observations, interviews and questionnaires are conducted. Observations made such as seeing the condition of the school and the presence or absence of learning support facilities. Interviews conducted with subject teachers aim to find out the characteristics of students. Questionnaire filling is done to find out the needs of students. Based on the results of observation, interviews and questionnaires a learning booklet was arranged.

After the three activities were carried out, the study continued at the next stage, namely design. Before making the booklet design the researcher reviewed the SK, and the KD material for the human digestive system. SK and KD were reviewed and formulated indicators and arranged in RPP. facts found in school, such as required images that can facilitate students in understanding the material. The
design produced at this initial stage is called draft 1. The design of the learning booklet is given an innovation, that is, on one page there is a pop up, besides that on some pages there will be a section of the book that can be opened and closed. A few pages with a section of the book that can be opened and closed, there is a question that serves to measure students’ analytical thinking skills. The questions behind the displayed image are also used as final evaluation questions.

The draft one that has been compiled is then validated to find out the feasibility of the booklet in terms of material and tool. This validation step is included in the develop stage. At this validation stage, booklet validation and 20 items validation were carried out. Booklet validation was carried out by material experts and tool experts. Validation of items was carried out by material experts. Validation results from material experts and tool experts produced draft 2 learning booklets.

The second draft of the Pop Up Booklet produced was then conducted a small class trial. Small class trials were carried out in the XII IPA class by taking a sample of 6 students. Eighteen students filled out a questionnaire about the use of learning booklets. In addition to questionnaires, the quality test also included validity, reliability, differentiation and difficulty levels.

The next stage is disseminate, carried out by testing the effectiveness of the use of learning booklets in class XI. This effectiveness test is carried out in the control and experimental classes. This aims to compare the learning outcomes of the two classes. Dissemination can be done in other classes to find out the effectiveness of using learning devices or in certain forums to get input for product improvement [11].

3.2 Discussion of Results
The data obtained in this study are, the results of the feasibility of two experts, and the results of testing the effectiveness of the use of the product.

The following is a comparison chart of the results of the feasibility of tool experts, and material experts.

![Comparison of Tool Expert Validation Results and Material Experts](image)

**Figure 1.** Comparison of Tool Expert Validation Results and Material Experts

The figure above shows the validation results of two experts, namely material experts and tool experts. From the results of the validation, the two experts gave different results, namely the difference of 2.16%. Based on the results of the validation the learning booklet is valid and can be used for testing in the next stage, namely small scale test and large scale test.
Table 1. Test Results Data Differences of Average Posttest Value of experimental class and control class

| Source of variation | control | experimental |
|---------------------|---------|--------------|
| Amount              | 766     | 2262         |
| N                   | 15      | 33           |
| Means               | 51      | 68.6         |
| Varians             | 232.36  | 166.18       |
| Standard deviation (S) | 15.24  | 12.89        |

Based on the table above obtained \( t_{\text{count}} = 351.951 \), with \( \alpha = 5\% \) and \( d_k = 15 + 33 - 2 = 46 \) obtained \( t_{0.05}(46) = 1.684 \). \( t_{\text{count}} > t_{0.05}(46) \), \( H_0 \) is rejected, so \( H_a \) is accepted, because \( t_{\text{count}} \) is in the rejection region \( H_0 \), it can be concluded that the posttest value of the experimental class is better than the posttest value of the control class.

The following is a comparison chart of the results of the effectiveness of the use of learning booklets in small class trials and large class trials.

Figure 2. Comparison of Small and Large Class Trials Test Results

Based on the graph above, it can be seen that the effectiveness of booklet use as a learning medium in small scale trials and large-scale trials. The data is based on a questionnaire that has been filled by students in class XII and class XI students. The results of small-scale and large-scale trials have different results, with a difference of 3%. Based on these results according to class XI students and class XII students the use of booklets as learning tool is considered effective.

There is a difference in the percentage of questionnaire results due to the small class trial, students are shown learning booklets and they are intooltely asked to fill in the questionnaire responses to the use of the booklet if the booklet is used for learning tool. This is because the small class trial was conducted at the XII IPA class where they had obtained the digestive system material in class XI. During the large-scale trial the learning booklet was used as a learning medium, after the learning activities were finished the students posttested and filled out the questionnaire responses. During the learning activities in class XI the students were interested in a booklet on the anatomical part of the organ that composes the digestive system, because all this time learning in the classroom was done by the lecture method. Therefore with the use of this booklet students become interested in learning biology.
A quality question is a matter that can provide accurate information - precisely about which students have mastered the material and which students have not mastered the material [12]. Therefore before the questions are used for pre-test and post-test, the item needs to be analyzed first. In this research, the items before being tested in class XII, the questions were first validated to the material experts but not done by the questions review card.

The problem used in this study is a matter of description, this is because the purpose of making this booklet is to improve students' analytical skills. Problem form description is a question whose answer requires students to remember and organize ideas or things that have been learned by expressing or expressing the idea in the form of descriptions [13]. Thus the question of the form of description is able to measure students' analytical skills.

Questions for evaluation after being assessed as quality, then used for pretest and posttest. Evaluation conducted is summative evaluation. Summative evaluation is intended to evaluate student achievement at the end of learning, this evaluation is designed to determine how far learning goals have been achieved [14]. Comparison of posttest results in both classes shows that the experimental class posttest mean is higher than the control class. This is because the experimental class uses pop up booklets as learning tool, while in the control class only uses textbooks. The improvement of analytical thinking skills in experimental class students is better than the control class. This is based on the increase in pretest and posttest scores in both classes. In addition, when the learning activities of students in the control class are still less active, it is different from students in the experimental class. Students in the experimental class at the time of learning had no one who was sleepy, and had actively participated in learning.

| Table 2. Comparison results of the two classes. |
|------------------------------------------------|
| Source of variation | control | experimental |
| Total of Student    | 15      | 33           |
| Average of Pre test | 21.4    | 31           |
| Average of Post test| 51      | 68.6         |

4. Conclusion
Based on the results of research and development conducted by researchers, it can be concluded that the development products in the form of Pop Up Booklets developed by the 4-D method (define, design, develop, and disseminate) are considered feasible and effective to be used as learning tool. Pop Up Booklet is considered feasible based on booklet quality assessment by material experts reaching a percentage of 89.56% and the results of the assessment by tool experts reached 87.40%. The percentage of student responses in the small class test was 77%, while the percentage of student responses in the large class test was 80%.

Pop Up Booklets that are used as learning tool are also considered as an effective way to improve students' analytical thinking skills. Pop Up Booklet is considered effective because the average results of the post-test experimental class are higher than the average results of the control class post-test. The average post-test experimental class was 68.8, while the average post-test control class was 51.

5. References
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