

Developing Adaptive Mobile Learning with the Principle of Coherence Mayer on Biology Subjects of High School to Support the Open and Distance Education

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Abstract: This study is a research development program of Adaptive Mobile Learning with Coherence Mayer principle on the subjects of Biology. The limitation of this study is application of mobile learning which designed adaptively to the three learning styles of learner i.e., the visual, auditory and Kinaesthetic. The provision of the three learning styles meant that the learners can learn the Biology material more easily appropriate to their learning style. The methods in the development of Adaptive Mobile Learning used method of R & D which refers to the development model of Alessi and Trollip. And then, the research and development program of Adaptive Mobile Learning conducted in Senior High School 11 Yogyakarta (SMA Negeri 11 Yogyakarta Indonesia), class of XI IPA-2. After product development, the validity of the products was tested by expert media and expert material. The value of validation test media and material reached 3.98 on good category (worth). Then, the product was tested in one class. Based on the test results, the developing of Adaptive Mobile Learning program had influence to increase the cognitive learning results of students on the subjects of biology. The results showed by the results of the comparison of the two averages N-Gain between pre-test and post-test results. Gain score showed the average 65.58. Then, the results of a pre-test and post-test also tested statistically to find out the extent of their significance. Based on the results of statistical tests obtained value of significance rating $0.000 < \alpha (0.050)$. Thus, it can be concluded that the Adaptive Mobile Learning program is effective to improve the learning results of students on the subjects of biology.

Keywords: adaptive, mobile learning, the principle of coherence mayer, learning styles

I. INTRODUCTION

In Biological learning, learners expect to understand the facts, concepts, principles, laws and theories about the living things and the environment as a whole. It aims the learners can connect to what they learn to the phenomenon of everyday life. Then, to achieve a deeper understanding related the biology learning material; it requires innovation in the learning process of Biology.

Basically, the learning innovation has been developed in order to remedy the shortcomings of conventional learning system implemented. According to Daryanto implemented learning conventionally resulting in learners does not learn effective and does not motivate, then causing the learners less or even do not understand the material that was taught by the teachers (Sugiyarto, 2014). It indicates the ability of teachers in the learning process needs to get serious concern. Then, based on the theory of VanDallen results of study influenced by 6 factors, namely: teacher, learner, curriculum, instructional media, environment, and learning methods (Sugiyarto, 2014).

One of the innovations that can be developed in order to correct the shortcomings of conventional learning system in Biology lessons is by utilizing the instruction media. Setiono said that the using of instructional media in the process of learning can arise the interest and willing a new, demotivating and evoking stimulus of learning process, even psychological influences to the learners. Instructional media basically has been indeed much developed to improve the quality of learning (Sugiyarto, 2014). One of the instructional media developments has been done by using of mobile learning.

Adaptive mobile learning is a program multimedia learning that presents learning materials through the mobile device and have ability to adjust

with characteristic of user learning style (student learning styles). The ability due to the special features of the program multimedia in the form of an instrument to measure learning style of the user before entering onroom material. Thus the user can learn according to the trend style of learning respectively.

II. METHODS

This research used R & D method (*Research and Development*) by adopting the model of development and multimedia design developed by Alessi and Trollip (2001). The procedure of this research development was only on the aspects of developing; produce *mobile adaptive learning*, through the three phases of development of Alessi and Trollip namely planning, design, and development.

At the stage of *planning* has been done by analyse the problems of Biology teaching materials facing on the students of Class XI, a preliminary survey related *mobile device* used by learners, making the development planning of mobile learning. Then, at the stage of *design* has been done by develop the *mobile learning* that comes from drawn up plans, determine the questions and statements that are able to analyse the learning style of students, also preparing the *prototype* according learning style (*visual, auditoria and kinaesthetic*). Furthermore, at the stage of *development* has been done by preparing the text, make the program code, producing audio, making each section into a single entity in the program, and test the installation on Android.

After the product has been developed, then the product was tested through experimentation. More specifically, the experimental design used *pre experiment pre* and *post-test design*, which was only conducted in one class and then to know the influence of the developed program carried out a comparison

between the results of pre-test and post-test learner results of cognitive learning Biology.

III. RESULT

The purpose of this research and development namely developing *Adaptive Mobile Learning* with principles of Mayer on the subjects of biology in High School in order to support the open and distance education. The following are some screenshots of the application program display.



Figure 1
Display the Menu of *Adaptive Mobile Learning* Program

Figure 1 showed the menu of *Adaptive Mobile Learning* program developed. Consisting of eight menus: (1) on the program contains information about developed programs; (2) A-MoL users Instructions containing navigation instructions when using the program; (3) SK & KD material contains standards of competence and basic competence of the material developed i.e. material motion systems; (4) learning objectives contains learning objectives to be achieved; (5) learning style test i.e. typical menu of the developed program, contains 25 items test instrument which aims to detect the dominant learning style of learner; (6) the learning material contains material that packaged into three options i.e. material for learner which dominant to the learning style *Visual*, *Auditory* and *Kinaesthetic*. it means that students are required to choose the material according to the style of their learning; (7) evaluation of learning i.e. the menu that contains the 15 item questions of competence and representing each of the indicators addressed in the materials; and (8) Developer's program A-MoL which contains the identity of the program developers, mentors, media expert and expert material.



Figure 2
Display the Menu Tests of Learning Styles in *Adaptive Mobile Learning*

Figure 2 the display of the menu tests learning style of learners contains descriptions and instructions about how to do the tests. The number of reserved entirely there are 25 reserved items and all of aims to index the dominant learning styles of each learner. By filling out the questions in the menu, the learners will know about their dominant learning style. Then the learner will able to choose the material that suit to their learning style.



Figure 3
The Display of the Test Results of Learning Styles

Figure 3 showed the display of the test results of learning styles learners. Thus, each learner will know the dominant style of learning.



Figure 4
The Display of the Menu Options Material According the Results Of Learning Style

Figure 4 showed the menu options display the material, there are three menus that able to select by each learner. For example, learners based on the test results of their learning style is dominant *Visually*, then they should choose the *Visual* material, Then for the results of their learning style *Kinaesthetic* dominant, then they should choose the material menu *Kinaesthetic*, also learners who dominant learning style is *Auditory*. It aims to provide the appropriate instructional media services appropriate their learning styles of each student. Paying attention to each material menu was designed in accordance to the characteristics of the learning styles of the learners.



Figure 5
Display of the Sample Material for The Visual Learning Style

Figure 5 example of the menu display material for learners who have the dominant Visual learning style contains text material and pictures. Text and pictures are presented coherently designed or related. It is like the principle of multimedia by Mayer (2009) i.e. the representation between text and pictures in the presence of media which need to relate each others. Pictures and text material displayed, but its do not associated to add the cognitive burden of the learners.



Figure 6
Display the Material for Learning Styles Auditoria

Figure 6 example of the display of material for learners who have *auditory* learning style dominant. One differentiator between presentation materials for learners which the Auditory dominant learning style with presentation material to other learning styles is the existence of a special button contains the recording of material in audio format. The way or working is simple i.e., when learners press the button of headset picture, it will pop up an audio containing a discussion of the material. And to stop the sound is by pressing the *headset* button on the disc.



Figure 7
Display of Material Kinaesthetic

Figure 7 showed the example of display material for learners who have a kinaesthetic learning style. On the kinaesthetic material, learners are presented the material in the form of text, pictures, accompanied with instructions, and it aim to activate motor sensory of the learners. Ideally, all activities carried out by learners when using *Adaptive Mobile Learning* program are all recorded in the material, but due to time limitations, the program development process, then motor sensory activation process of learners do not be recorded yet by the program.

In addition, the developed program is equipped with a glossary. Glossary menu is one of the menus that are developed in accordance with the analysis of the needs of the learners. According to Observation result, the learners admitted about difficulties in understanding and remembering the meaning of unfamiliar terms in the subject matter of biology. By menu of glossary expected learners will get ease when search for the meaning of the term of intended understand. In the application, the learners just push the button G which means the glossary, and then search for the first letter of the word to what they want.

Developed the program is equipped with a menu of competency test questions for exercise to learners after they learn all the material in the *Adaptive Mobile Learning* program developed. The number of entirely items is 15 items representing every indicator and purpose of material covered and presented in the program of *Adaptive Mobile Learning*.

This study used two types of data namely the eligibility assessment program *Adaptive Mobile Learning* and cognitive learning outcomes learner. The following tables are the description the data of qualifying product results that obtained from the mean score of the experts and learners on every aspect of eligibility on *Adaptive Mobile Learning* product, i.e. as follows (Table 1).

Table 1
Data Qualification of Validation Results of Media Expert

No.	Feasibility Aspects	Media Expert	Category
1	Easy of operation	4.00	Good
2	Easy of Navigation	4.25	Very good
3	The Quality of Display	4.20	Good
4	The Quality of The illustrations	4.10	Good
5	Interest	4.50	Very good
Average		4.21	Very good

The following table is the result of an assessment of the feasibility of *Adaptive Mobile Learning* program based on expert material (Table 2). The following table is the results of validation and responses to learners about the *Adaptive Mobile Learning* program which has been developed (Table 3). The following result is a comparison score of the results of the *pre-test* and *post-test* on field test which can be seen in the following table (Table 4).

Based on the analysis of the results of a *pre-test* and *post-test* improved value (*gain score*) significant i.e. of 93,53%. The value of *gain score* showed the

addition of the average score was significant. It means that the *Adaptive Mobile Learning* program effect significantly to improved the learning result of learner. Next, after the value of gain score of cognitive learning results has been known, then testing to answer the research question whether *Adaptive Mobile Learning* program that developed has influential study results significantly to learners.

Before the data are statistically tested, the data needs to be the prerequisite, in this case is a test of normality. Normality test results can be found in the following Table 5.

Table 2
Table Qualification of the Results the Validation of Expert Material

No.	Feasibility Aspects	Expert Material	Category
1	The relevance of the material	3.75	Good
2	The suitability of the material with the development of the learners	4.00	Good
3	Consistency of presentation materials	4.00	Good
4	Opportunity of presentation material in achieving the indicators of learning	3.50	Good
5	The quality of the presentation	3.86	Good
6	The quality of the illustrations	3.17	Less
7	Quality test	4.00	Good
Average		3.75	Good

Table 3
The Response of Learners about Adaptive Mobile Learning Program

No	Aspects of Assessment	Score	Feasibility
1	The relevance of the material	3.7	Good
2	The suitability of the material with the development of the learners	3.2	Enough
3	Consistency of presentation materials	3.7	Good
4	Opportunity of presentation material in achieving the indicators of learning	3.5	Good
5	The quality of the presentation	3.53	Good
6	The quality of the illustrations	3.3	Enough
7	Easy of operate	3	Enough
8	Aesthetic Display of the application	2.8	Enough
9	Easy of navigation	3.07	Enough
10	The quality of the illustrations	2.8	Enough
Total average		3.26	Enough

Table 4
Score of Comparisons to the Average Pre-test and Post-test

Average	The Mean of Pre-test	The Mean of Post-test
The Amount of Score	13.6	26.3
The value of the	34.0	65.8
Gain Score = $\frac{\text{Rata Posttest} - \text{Rata Pretest}}{\text{Rata} - \text{rata Pretest}} \times 100\%$		
Gain Score = $\frac{65.8 - 34.0}{34.0} \times 100\%$		
Gain score = 0.935 x 100%		
Gain Score = $\frac{65.8 - 34.0}{34.0} \times 100\%$		
Gain Score = 93,53%		

Table 5
The Results of Normality Test of the Learners Cognitive of the Results of Study
Tests of Normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	df	Sig.
Post	.357	30	.000	.546	30	.000

a. Lilliefors Significance Correction

Table 6
The Test Results of Two Related Samples
Test Statistics

	Post-Pre
Z	-4.715 a
Asymp. Sig. (2-tailed)	.000

a. Based on negative ranks.

b. Wilcoxon Signed Ranks Test

Based on a test of normality, it has been known at level of significance 0.000, the result is the value of significance $< \alpha$ (0.05), it means the data is distribute normal. Thus, the test continued using non-parametric statistical tests of *two related samples*. Test results showed in the figure to the following Table 6.

Based on the significance value above obtained the value of sig. 0.000. Significance values $0.000 < \alpha$ (0.05). Then it can be concluded that the *Adaptive Mobile Learning* program that developed was effectively enhance learning outcomes. According to the test results of *gain score* and test of 2 related sample using SPSS above, it can be concluded; there is a difference between the value of the test results before (pre-test) and after (post-test) using *Adaptive Mobile Learning* program. Thus the development of *Adaptive Mobile Learning* on subjects of High School of Biology influenced to increase the results of the study of the cognitive aspects of learners. On the other hand

when it compared to the value of the minimum completeness criterion (KKM) Biology = 75, the results of the average value of post-test students 65.58. It showed that the average *post-test* $<$ under minimum completeness criterion (KKM) or $65.58 < 75$. Thus, learning using *Adaptive Mobile Learning* program has not reached the KKM in specified.

Based on the results of the assessment of media experts and expert material on *Adaptive Mobile Learning* program gained an average rating for each of the following expert (Table 7). Based on the table above, it can be concluded that the assessment of media experts and experts' materials are different by any experts. However, in general view from the average value from both validation obtained score of 3.98. To find out which category of products that developed, using products eligibility criteria table, as follow (Table 8).

Table 7
Comparison Table of Validation Content Material and Media

No.	Expert	The value of the	Criteria
1	Media Expert	4.21	Very Good
2	Expert Material	3.75	Good
Average		3.98	Good

Table 8
Scale Value Criteria

The Value	Criteria	Score	
		The Formula	The Calculation
A	Very Good	$X > X_i + 1.80 \text{ SB}_i$	$X \ 4.21 >$
B	Good	$X_i + 0.60 \text{ SB}_i < X \leq X_i + 1.80$	$3.40 < X \leq 4.21$
C	Enough	$X_i - 0.60 \text{ SB}_i < X \leq X_i + 0.60 \text{ SB}_i$	$2.60 < X \leq 3.40$
D	Not good	$X_i - 1.80 \text{ SB}_i < X \leq X_i - 0.60 \text{ SB}_i$	$1.79 < X \leq 2.60$
E	very bad	$X \leq X_i - 1.80 \text{ SB}_i$	$X \leq 1.79$

Based on a table of criteria, it can be concluded that the value of the results of the validation test media and material reached 3.98 and belong to good category. Thus the product of *Adaptive Mobile Learning* that developed in High School on Biology subject material of human motion system was "good/decent" as a medium of learning biology.

After the process of test validation of media experts and expert content, *Adaptive Mobile Learning* program was not through a limited test in advance because of limited time. In this case, time limitations associated with the validation time material and the media suffered a setback, however, on the other side of the material motion systems will be learnt at school. Thus, *Adaptive Mobile Learning* programs directly applied to field test. Field test conducted to learners of SMA Negeri 11 Yogyakarta of class XI IPA-2. The purpose of Field test was to operate the situation and condition of products in a real class. Through the results of the application of the product in a real classroom will be retrieved information about learner response towards the assessment of development result and the results of a study of the cognitive aspects of learners during a learning process. Following will show the complete discussion of each of the data.

The response of the learners in the form of *Adaptive Mobile Learning* assessment of the results of

the development by ten aspects was assessed; there were four aspects of the sign in the category of good, i.e. aspects of relevance, consistency of presentation material, material presentation opportunities in achieving the learning, and indicators of the quality of the presentation. While the six other quality aspects of enough (medium), i.e. aspects the suitability of the material with the development of the learners, the quality of the illustrations, easy to operate, the display of aesthetic applications, easy of navigation, and the quality of the illustrations. Thus, it can be concluded that the *Adaptive Mobile Learning* got sufficient assessment of learners.

Then, the score comparison of average value of *pre-test* and *post-test* results obtained average scores for *pre-test* 34.0 and average score for the *post-test* 65.8. Judging from the comparison of *pre-test* and *post-test* results can be concluded that there was positive difference in value; it means there was an increase in cognitive learning results of learners. In order to strengthen the results of the research, researchers calculate the value *gain score*. The results of data analysis *gain score* presented in the form of a percentage, then shown the increase the ability of definitive achievement of learners by observing the ability first. Based on the calculation of the *gain score* obtained results an increase of 93,53%.

Not only by *gain score*, also the analysis of there is an increase or no increase in cognitive learning outcomes of learner can be known through test 2 *related sample tests* (Wilcoxon Test). The Analysis is used to find out is there a different or is there no difference on one factor with two observations, by way of looking at the significance of these two factors. According to the results of the calculations by using the test 2 *related samples test* (Wilcoxon Test) by SPSS 16.0 obtained the results that the absolute value of sig. was 0.000. It means that the value of significance $0.000 < \text{value } \alpha (0,005)$. Then, it can be noted that there are significant differences between the average value of test results before (*pre-test*) and after (*post-test*) using *Adaptive Mobile Learning* program. Thus, it can be concluded that *Adaptive Mobile Learning* program impact an increase in cognitive learning results of students on the subjects of biology.

IV. DISCUSSION

Mobile learning is an innovation in the field of learning, which enables the learning process more flexible, because learning does not always learn in the classroom or laboratory. In the context of learning, *mobile learning* plays a part as a system of learning, medium of learning or a source of learning materials. Those can utter new innovations, for example *mobile learning* as a media and learning resources, utters a wide range of application programs, either paid or unpaid applications which can be accessed by all people, including students. One of the *mobile* operating system platforms unpaid which have been much developed in the development of the instructional media program, i.e. Android-based program.

The development of Android-based *mobile learning* has had been potential due to majority of the learners using the Android-based mobile phones. It is confirmed by the results of pre-registration survey conducted on students in SMA N 11 Yogyakarta, obtained information that Android user occupied number 87.1%, whereas IOS 6.5%, Windows, Simbian and BB respectively 3.2%.

Huang, Wang & Hsieh (2012) explains that in order to facilitate diversity available mobile devices need improve the comfort and efficiency of learning in a mobile learning environment. In addition it is necessary effort to identify the capabilities of each device individual, content adjustment can provide solutions to diversity user device. Therefore required a diagnostic mechanism learning to know knowledge early learners, each learning style learners.

Then, it retrieved from other information that learners do not make yet the utilizing of *mobile device* optimally for learning. Because, the learners in general more utilize the mobile device to access social media accounts. Based on the results of the pre-survey obtained data respondents who have social media type of BBM is 28 respondents or amounted to 90.3%, then Twitter users is 25 respondents or 80.6%, furthermore Google+ users is 19 respondents or 61.3%, Whatsapp users is 29 respondents or 93.5%, Instagram users is 22 respondents or 71%, Skype users is 10 respondents or amounting to 32.3%, Facebook users as much as 24

respondents or amounting to 77.4%, path user is 17 respondents or 54.8% and other social media users is 1 respondents or 3%.

Android-based mobile learning has been heavily developed into a medium of instruction. However, the utilization of mobile learning that has been developed in general has not followed the principles of multimedia development. One of the widely used references regarding the principles of multimedia in learning is Mayer (2009) and he stated that development of *mobile learning* will be more optimal usage if paying attention to the diversity of learning styles learners (student learning style). Then, to achieve the goal of high school Biology learning oriented on the development of thinking ability and utilization technologies, required the development of mobile learning which adaptively to the style of learning (learning style) learners and paying attention to the principle of coherence in development. By identified the learners learning style, then learners will access the mobile learning appropriate to learning style. Thereby, the goal is the attempt to achieve the learning learner results more effectively and efficiently.

In the learning process educators must be able to read characters dominant learners. There fore learning service programs can be packaged accordingly with the most dominant characteristics. One of the characteristics of the learner can beto note is the difference in style learning. Learning styles learners havethe difference between one another (Surjono, 2011). In some studies it was obtained the conclusion that adaptive mobile learning proven effective to help learners learn to achieve learning objectives in a manner effective and efficient. Besides adaptive mobile learning facilitate the learning process because it can be done without time-bound and room. Users can learn anytime and anywhere as needed for him learn.

V. CONCLUSIONS AND SUGGESTIONS

Conclusion

In developing the *Adaptive Mobile Learning* program on Biology subject need pay attention to some aspects of the media, including the easy to operate, easy of navigation, display the quality, the quality of the illustrations and display interest, which is judged by media experts and categorized "very good". Then, on the aspect of the material, such as relevance of material, suitability of materials with learners, the consistency of the presentation of the material, the material presentation opportunities in achieving the learning, quality of presentation indicator, quality illustrations and quality tests, which are judged by an expert materials and categorized "good". Furthermore, the combination of some aspects of media and the material aspect is assessed by learners as user, obtained the category of "enough". Based on that data, it can be inferred that the *Adaptive Mobile Learning* Biology (A-MolBio) is pretty decent to use. In addition, based on a comparison between the results of a *pre-test* and *post-test* students obtained *gain score* of 93.53%. Then, based on statistical tests obtained significance rating $0,000 < \alpha (0.050)$. Thus, it can be concluded that the

Adaptive Mobile Learning Biology influence to increase the cognitive learning results of learners.

Suggestion

Adaptive Mobile Learning has been developed based on the needs analysis on site research which has been in SMA N 11 Yogyakarta. However, the development of *Adaptive Mobile Learning* Biology is not optimal because the stages of development are not through the process of limited test. Thus, in order for *Adaptive Mobile Learning* Biology developed can be more optimally, then it needs to continue testing using a limited test in advance. Then, on the application of kinaesthetic learning style, require revision in order the learners who have a kinaesthetic learning style can be optimally fulfilled for their learning style.

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