Development of Android-Based Mobile learning media on Atomic Structure and Periodic Table

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Abstract. This study aims to develop an Android-Based Mobile Learning Media on Atomic Structure and Periodic Table. The development of mobile learning media adapted the research and development stages by Borg & Gall which was reduced to three stages: needs assessment, media development, and media testing. Mobile learning media that has been developed is an Android-based application (*.apk*) named ATOMOB, with size less than 45 MB compatible on Android devices with variety of screen resolution sizes. It was reviewed by expert of chemistry, expert of multimedia, chemistry teachers, and students. The quality of this media was determined based on the aspect of subject matter, language, operating process, audio and visual display. The assessment data are collected from 10 experts, 5 chemistry teachers and 100 senior high school students by using Likert questionnaire. Overall interpretation of assessments by experts, students, and teachers resulted in very good criteria on each assessment indicator. This mobile learning media can motivate students to learn more about chemistry because students said this media is interesting, attractive, and make learning more meaningful. Therefore, mobile learning media that has been developed is feasible to be used as learning media and suitable with students' needs.

1. Introduction

Advances in technology bring various impacts in education. Teachers in the 21st century are no longer be the only source of learning for students, but also as active mediators and facilitators to develop students' potential [1]. Development of learning media also has linear connection with technological advances. Media utilization is one of the efforts to create meaningful learning process and improves quality output. Advanced technology such as LCD, projector, e-library, and e-learning are already familiar in education. Currently, smartphone has great opportunities to be utilized as a learning media since its presence in 2010, it has distributed around the world and several operating system, but today Android became the most widely used platform in the world [2].

Indonesia has been on 7th place as the country with the most smartphone users [3]. Nevertheless, the utilization of smartphone as a learning media still needs to be developed beside its function as communication or entertainment device [4]. One of the smartphone-based learning that can be used by teachers is Android-based mobile learning. Mobile learning is one of alternatives learning process that practical and highly potential to makes learning more easy and effective [5, 6]. It's brings many benefits such as solving teachers' issues in terms of time management as well as increasing students' independence to understand the lessons. Students can repeat the lesson to fill leisure time whenever and not limited by time or place [7, 8, 9]. Research by Huang et.al prove that through mobile learning,

students' motivation in attention, relevance, confidence, and satisfaction (ARCS) increased significantly [5]. In addition, Al-Emran explain that the attitude of students and educators who have used mobile learning is better when compared with they who never use it [10]. Research and development related to mobile learning media has penetrated into Indonesia. Previously, the development of mobile learning media "ChemEdu" based on the 2013 curriculum enhanced the academic performance of SMA/MA students [11]. In 2016 there has been research and development of mobile learning media on Reaction Rate. It deserves to be used as a learning media which is practical, economical, movable, and in accordance with the students' needs [12].

Based on the observations of researcher during the internship at SMAN 78 Jakarta, students have difficulty when understanding Atomic Structure and Periodic Table. This fact is supported by data from the questionnaire of students' needs assessment which revealed that 63% of students from 35 respondents stated that Atomic Structure and Periodic Table is an abstruse subject matter or difficult to understand. This is in line with the questionnaire data of teachers' needs assessment, 2 out of 3 respondent teachers stated that abstruse lesson and too many rules make it difficult for students. Through the conditions that have been exposed, both students and teachers need an innovative learning media so students more easily understand the lesson in a fun way and overcome the problem of limited time in teaching. Therefore, this research aims to develop Android-based mobile learning media on Atomic Structure and Periodic Table which was expected to be the solution for the problems and feasible to be used as learning media that suitable with students' needs.

2. Research methodology
The research methodology that has been used is the Research and Development (R & D) which refers to Borg & Gall [13], this research methods used to produce a certain product and test its effectiveness. Borg & Gall research and development model consists of 10 stages which are then reduced to three stages: needs assessment, media development, and media testing.

Data collection techniques conducted in this research include: (1) classroom observation, (2) needs assessment questionnaires of students and teachers, (3) questionnaires of experts (chemistry and multimedia experts), (4) mobile learning media (product) assessment questionnaires of teachers and students [14].

3. Results and discussion

3.1. Result of needs assessment analysis
During the study of the Atomic Structure and Periodic Table, students used the books, worksheets, and internet as learning resources. Teachers also acknowledged that the learning process still relies on the books as the main learning resource. Questionnaires revealed that there are 92% of students who use smartphones with Android operating system and 43% of them know about mobile learning but only 29% of students who have used the mobile learning media to help their learning process. In addition, all students and teachers were agree that they need mobile learning media which consists of lesson summaries, quiz, and the solution.

3.2. Media development
Development of Android-based mobile learning media consists of these steps: the analysis of software necessity, designing media, development, and testing. Based on the needs assessment analysis that has been done, researchers designing the concept of mobile learning media that will be developed with several software such as *Adobe Flash Professional CS6* for programming and *CorelDraw* for graphic design. The process includes making content scenarios that are related to the lesson, it began with sorting lessons from various sources according to the latest curriculum, describing indicators through basic competencies, making lesson summaries, quiz, and its solution. In addition, at this stage the researchers also make the concept of visual design, so that the media developed not only interesting in terms of content but also has attractive visual (Figure 1). The development used AIR for Android with

*ActionScript 3.*0 as programming language. The output file can be used in mobile device like smartphone or tablet (extension *.apk*), it can also be used on browser (either extension *.swf*, *javascrip*t, or *HTML5*) [7].

Figure 1. Mobile learning media display.

3.3. Media testing

Android-based mobile learning media that has been developed named ATOMOB assessed by 5 chemistry experts, 5 multimedia experts, 5 chemistry teachers, 20 students for smale-scale testing, and 100 students for large-scale testing. By installing the *.apk* file, then the assessors judged the quality of the mobile learning media to define the feasibility using questionnaire with Likert scale and give comments to revision stage.

The assessment was based on big 4 aspects, they are subject matter, language, operating process, audio and visual display. The data were analyzed to determine the quality of Android-based mobile learning media according to the table of ideal criteria based on experts assessment. Details of experts assessment results can be seen in table 1 and table 2.

Table 1. Quality assessment by chemistry experts.

No	Aspects	Percentage	Criteria
1	Subject matter	93%	Very good
2	Exercise and solution	89%	Very good
3	Language	90%	Very good
	Average	91%	Very good

Table 2. Quality assessment by multimedia experts.

No	Aspects	Percentage	Criteria
1	Audio visual	93%	Very good
2	Software functional	96%	Very good
	Average	95%	Very good

Media testing by teachers consists of six aspects. The assessment results have a "very good" criteria with an average percentage 94% which displayed in table 3. Teachers also gave suggestions for further development such as add more games and quiz so students can learning chemistry with a fun way.

Table 3. Quality assessment by chemistry teachers.

No	Aspects	Percentage	Criteria
1	Subject matter	93%	Very good
2	Exercise and solution	94%	Very good
3	Language	95%	Very good
4	Audio visual	94%	Very good
5	Software functional	93%	Very good
6	Usefulness	90%	Very good
	Average	94%	Very good

ATOMOB presents in an attractive and colorful layout with sound effects and music which enhance its attractiveness. The quality of audio visual and the content were very good based on students' responses. Details of small scale students assessment results can be seen in table 4.

After revised, large-scale student do the media testing. The percentage of quality increase from 92% to 93% with the highest percentage achieved on aspect usefulness as presented in table 5. This result in line with some pre-existing studies that there is increasing percentage eligibility on media testing from small-scale to large-scale[11,12,14,15,16].

Table 4. Quality assessment by small-scale students.

No	Aspects	Percentage	Criteria
1	Exercise and solution	95%	Very good
2	Language	91%	Very good
3	Audio visual	91%	Very good
4	Software functional	90%	Very good
5	Usefulness	95%	Very good
	Average	92%	Very good

Table 5. Quality assessment by large-scale students.

No	Aspects	Percentage	Criteria
1	Exercise and solution	94%	Very good
2	Language	92%	Very good
3	Audio visual	91%	Very good
4	Software functional	92%	Very good
5	Usefulness	96%	Very good
	Average	93%	Very good

This Android-based mobile learning media consists of lesson summaries, videos, quiz and the solution. Figure 2 presented the display of lesson summary and videos in mobile learning media. Question type in the quiz is multiple choices questions, at the end of the quiz the final score and solution button showed, so the students can learn the right answer.

Figure 2. Videos and Lesson summaries on media.

Based on both results of media testing by students and teachers, mobile learning media that have been developed meet the criteria of "Very Good" which is indicating that the Android-based mobile learning media is feasible to be used as an alternative learning media in the learning process.

3.4. Implications for students

The data from questionnaires showed that the students were very interested while using ATOMOB. Students' responses also indicated that it is very useful and helpful in understanding the lesson because of the simple and systematic explanation is provided with attractive design. They also thought that this Android app were very helpful especially about the practical usage because they can bring it mobile. So, they can learn not only in the classroom but also apply self-studying outside the classroom. When they can keep learning using the mobile learning media whenever and wherever they are, it could impact on increasing up their motivation for learn chemistry [17].

Android-based mobile learning media offers new experience for students and makes learning process more meaningful and attractive. It has advantage especially in delivering message to make the material clearer, because of composition elements such as text, sound, animation, video, and interactivity. There are some common reasons why students more attracted to use media, such as entertainment, exploration, social lubrication, exercise, and needs for acknowledgement [18].

The material of atomic structure and the periodic table is generally presented in the form of books, websites , slides or handouts. The form of Android-based mobile learning media for this kind of subject matter is never encountered by some students, so it is become more interesting than other forms of learning media. Another reason that makes the students become interested in mobile learning media is because it was provided in offline form, so it can be used anywhere and anytime without any time limitation, even if the smartphone does not have internet connection.

4. Conclusions

Android-based mobile learning media on Atomic Structure and Periodic table has been successfully developed by adjusting the needs assessment of students and teachers. This media contains lesson summaries, videos, quiz and the solution. Product development research in the form of Android-based applications named ATOMOB.apk with a file size of 43.41 MB compatible on Android devices with various screen resolutions.

The results of the overall feasibility test by experts, students, and teachers, have the "Very Good" criteria. It also can motivate students to learn more about chemistry. So, mobile learning media that has been developed is feasible to be used as learning media and suitable with students' needs.

References
[1]   Rusman 2013 *Belajar dan Pembelajaran Berbasis Komputer* (Bandung: Alfabeta)
[2]   Top 8 Mobile Operating System in Indonesia from January to September 2016. From: http://gs.statcounter.com/ #mobile_os-ID-monthly-201601-201609-bar Accessed at Dec 21 2006
[3]   2 Billion Consumers Worldwide Smartphones by 2016 From: http://www.emarketer.com/Article/2-Billion-Consumers-Worldwide-Smartphones-by-2016/1011694. Accessed at Dec 21, 2006.
[4]   Husamah 2014 *Mobile learning, Siapa Takut?* Koran Pendidikan UMM Edition 8-14
[5]   Huang CSJ, Yang SJH and Chiang THC 2016 Effects of Situated Mobile learning Approach on Learning Motivation and Performance of EFL Students *Edu. Tech. Soc.***19**(1) : 263–276
[6]   Peters K 2007 m-Learning: Positioning educators for a mobile, connected future *International Review of Research in Open and Distance Learning* **8**(2)
[7]   Romiyatun DA, Jaslin I and Lis PS 2012 Pengembangan Mobile Game "Brainchemist" Sebagai Media Pembelajaran Kimia SMA/MA Pada Materi Teori Atom Mekanika Kuantum, Ikatan Kimia Dan Termokimia *Jurnal Pendidikan Kimia FMIPA Universitas Negeri Yogyakarta* **1** (2) 1-9
[8]   Traxler J, Defining, Discussing and Evaluating 2007 Mobile Learning. *International Review of Research in Open and Distance Learning* **8**(2)
[9]   Wen-Chun Wu and Yeng-Hong Perng 2016 Research on the Correlations among Mobile learning Perception, Study Habits, and Continuous Learning *Eurasia Journal of Mathematics Science and Technology Education* **12**(6)1665-1673
[10]   Al-Emran, Mostafa, Hatem M, Elsherif and Khaled S 2015 Investigating Attitudes Towards The Use Of Mobile learning In Higher Education *Computers in Human Behavior* **56** 93-102
[11]   Sugiyarto 2015 Pengembangan Media Mobile learning "Chem Edu" Berbasis Android sebagai Suplemen Materi Kimia Berdasarkan Kurikulum 2013 untuk Meningkatkan Academic Performance Siswa SMA/MA *Laporan Hasil Penelitian Tim Pascasarjana UNY*
[12]   Hasyrin S N 2016 *Pengembangan Media Mobile learning pada Materi Laju Reaksi* (Jakarta: Universitas Negeri Jakarta) Thesis
[13]   Borg W R and Gall M D 2006 *Educational research: An Introduction, Eighth Edition* (New York and London: Pearson Education)
[14]   Paristiowati M, Irma R K and Aftuni 2011 Pengembangan Bahan Ajar Berbasis ICT pada Mata Pelajaran IPA-Kimia SMP *Jurnal Riset Pendidikan Kimia* **1** (1)
[15]   Paristiowati M and Amanda F 2014 Development of Online Learning Using Moddle Version 2,5,3 (Case Study at Secondary Schools Jakarta) *Proceeding of International Conference on Research Implementation and Education of Mathematics and Sciences Yogyakarta State University* 39-46
[16]   Cahyana U, Maria P and Aftuni 2017 Web-Based Learning Resources and Students' Scientific Aptitude: Lessons From The Implication of Profesional Learning Community *INTED 2017 Proceedings* 3693-3700

[17]   R Manda, H Nurlaila and Indri 2017 Development of Web-Based Computer Assisted Language Learning In English Intensive Course 2017 *1st Annual Applied Science and Engineering Conference Materials Science and Engineering* 180

[18]   Anneta L A 2008 Video Games in Education: Why They Should Be Used and How They Are Being Used *Theory Into Practice* 4**7**: 229-239