Development of android-based chemistry learning media oriented towards generic science skills

D Wiguna1, F S Irwansyah1*, N Windayani1, H Aulawi2 and M A Ramdhani3

1Department of Chemical Education, UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia
2Department of Industrial Engineering, Sekolah Tinggi Teknologi Garut, Jl. Mayor Syamsu No. 1, Garut 44151, Indonesia
3Department of Informatics, UIN Sunan Gunung Djati Bandung, Jl. A.H. Nasution No. 105, Bandung 40614, Indonesia

*ferli@uinsgd.ac.id

Abstract. This study aims to describe the production stages and the eligibility value of Android-based learning media oriented towards students’ generic science skills on the concept of colloids. This study uses Research and Development method with three stages, namely analysis, design, and development. Analysis stage produces conceptual connectivity and generic science skill indicators in concept presentation strategies. Design stage produces flowchart and storyboard, and development stage produces Android-based learning media with conceptual characteristics presented through materials and directional questions to develop generic science skills, equipped with visualization in the form of videos, pictures, and texts. The result of validity test conducted by chemists and media experts is declared valid with the value of rcalculate = 0.8-0.9. The result of limited trials conducted to chemical education students shows that 90.76% of them agree and 9.24% disagree. These results indicate that Android-based learning media oriented towards generic science skills is feasible to use in learning the concept of colloids.

1. Introduction
The 2013 curriculum is a competency-based curriculum designed to anticipate the needs of 21st century competencies where creativity and communication skills will be more important [1]. In this era of 21st century education transformation, the flow of change happens as the important role in learning activities will be equally played by teachers and students. The teacher in the 21st century plays a role as an active mediator and facilitator, while student as an active subject as well as an object in learning [2].

The development of technology has now created a new breakthrough in the development of education technology as a human effort to improve the quality of life [3]. Educational media is required as an intermediary messenger, in order to minimize failure during the learning process [4]. Learning media is used as a tool to build visualization adapted from the materials in the form of words, images, or animations [5]. Multimedia is a digital product that presents and combines text, images, sounds, audios, and videos, which can be used by autodidact or students in the class. Nowadays multimedia is more into computers and other digital devices whose development follows the rapid development of technology [6]. Multimedia in the learning process has proven able to: enhance learning motivation, improve the effectiveness of learning [5], create a fun learning atmosphere [7], create student-centered
learning, and enhance the investment efficiency of learning tools, and increase the understanding level [8]. In addition, the implementation of multimedia-based learning applied on Android platform reportedly has a good level of effectiveness to support the learning process of science [9,10].

According to Khasanah [11], chemistry is a science that seeks answers to the question of what, why, and how natural phenomena relate to the composition, structure and properties, change, dynamics, and energetics of matter. This means that teachers should be able to generate students' skills and abilities in learning and generic skills to be one of the skills that students can bring up in their learning. One of the media that has been developed is "CHEMONDRO®" learning media for colloid materials for the second grade of senior high school students majoring in science. This media was developed by Prasetyo and Irwanto [12] and considered feasible to use in chemistry learning in schools.

Generic skills are one of the main skills used to improve the quality of Human Resources in the 21st century. In carrying out this effort, education today has a very important role, in this case, to prepare competent graduates [13]. Generic science skills to know include direct observation, indirect observation, symbolic language, sense of scale, logical frame and consistency, logical inference, law of causality, mathematical modelling, and concept building [14].

Based on the background and some research results explained, it is necessary to conduct a research on the learning process utilizing Android-based multimedia based on generic science skills on the concept of colloids by adding other generic science skill indicators.

2. Methodology

Research design used in this study is Research and Development (R&D) method. Research and Development method consists of four stages, namely define, design, develop, and disseminate [15]. In this study, we modify these four stages into three, namely define, design, and develop. The procedure used in this study is also divided into three stages, namely the preparation stage, the implementation stage and the conclusion stage.

Validation test of an instrument can be done by comparing the feasibility value \( r \) of an instrument with specified critical \( r \) value, generally critical \( r \) is used to define the validation limits of an instrument, whose value is set at \( r = 0.3 \) [14].

\[
\text{r} = \frac{x}{N \times n}
\]

**Description:**
- \( r \) = value of eligibility
- \( x \) = weight of respondents' answers
- \( n \) = number of respondents
- \( N \) = number of items

To find out student response to learning media based on android used formula as follows:

\[
P = \frac{F}{N} \times 100\%
\]

**Description:**
- \( P \) = Percentage of respondents' answers
- \( F \) = number of respondents' answers
- \( N \) = number of respondents

Criteria response of students to android-based learning media expressed strongly when the percentage of \( = 61\% \).

This study is conducted to students of the Department of Chemical Education, UIN Sunan Gunung Djati Bandung. The sample in this study includes the fifth semester student teachers selected randomly. Data collection is done using a validated questionnaire instrument given to chemists, chemistry learning experts, media experts and respondents.

3. Results and discussion

The development of Android-based chemistry learning media begins with define or analysis stage. First, it begins with doing an analysis of the concept of colloids. This stage aims at producing an appropriate
and systematic conceptual presentation as well as learning the characteristics of the concept in colloid materials, such as its labels, attributes, hierarchy, types, examples and non-samples. Second, the conceptual analysis that has been compiled is changed into a chart showing the relationships between concepts called concept maps.

The next stage is the design stage. At this stage, all elements of the media are integrated into learning media to make it easier to describe with the flow of the elaboration of the materials and the illustration of the linkage between concepts. Therefore, it requires a flowchart and storyboard to be the tools integrating all elements of the media in this Android-based learning media.

The third step is the development of the Android-based learning media according to the storyboard. The software used to develop this learning media is Android Studio with Java programming language. After the learning media is completely finished, it is saved in ‘.Apk’ format so that it can be run on android-based smartphone.

Figure 1 shows the display of the main menu presented on the Android-based learning media, consisting of some features such as: competency, learning materials, quiz, instructions, information, volume bar, and exit menu. Figure 2 shows the display of learning materials consisting of four materials according to basic competencies that have been determined. These four materials include, the types, the properties, the making, and the role of colloid.

Figure 3 illustrates the display of the quiz options presented in two types namely essay and drag-and-drop method, and multiple-choice. Essay quiz consists of ten questions. Figure 4 illustrates multiple-choice quiz consisting of 15 questions.
Figure 5 shows the feedback received by a user of the Android-based learning media where if a user answers the questions with score >70, a discussion column will appear, containing a discussion about the question presented. Then, the user can choose to continue the quiz or go back to the main menu.

![Figure 5. The display of the quiz result and feedback.](image)

3.1. The validation Results of android-based chemistry learning media oriented towards students’ generic science skills on the concept of Colloid

Before this product, android-based learning media, undergoes trials, it is first validated by the expert team. The first test conducted is validity test conducted by chemists, chemistry experts, and media experts. The assessment is conducted using a questionnaire that contains assessments of several aspects, namely the aspect of concept’s validity, breadth and depth of concept, material and matter, language structure, media display, software engineering, and implementation. The validation result obtained from the questionnaire data process is presented in Table 1.

| No. | Indicator observed                        | r_{hitung} | r_{kritis} | Result |
|-----|------------------------------------------|-------------|-------------|--------|
| 1   | Aspect of concept’s validity              | 0.91        | 0.3         | Valid  |
| 2   | Aspect of breadth and depth of the concept| 0.87        | 0.3         | Valid  |
| 3   | Aspect of materials and questions         | 0.83        | 0.3         | Valid  |
| 4   | Aspect of language structure              | 0.85        | 0.3         | Valid  |
| 5   | Aspect of media display                   | 0.90        | 0.3         | Valid  |
| 6   | Aspect of software engineering            | 0.92        | 0.3         | Valid  |
| 7   | Aspect of implementation                  | 0.86        | 0.3         | Valid  |
|     | Average                                   | 0.88        | 0.3         | Valid  |

Based on the table of validation results above, the indicator with the highest value namely r_{hitung} 0.92 is the aspect of software engineering. Meanwhile, the one with the lowest value namely r_{hitung} 0.83 is the aspect of materials and questions. The validation results on all aspects assessed show that the relationship between the all aspects and the generic science skills is valid and feasible to use as independent learning resources. This shows that all aspects are valid and this android-based learning media is feasible to use as learning media. It is in line with the statement of Efrosius [16] that the type of media must be in accordance with the learning needs and objectives; not only makes the learning process easier and efficient, but also makes it more interesting.
3.2. The results of the limited trials conducted to students

The second test is the limited trial conducted to students. The assessment is done by using a questionnaire containing YES and NO questions for several aspects, namely aspects of learning, material substance, visual communication, and software engineering. After analysing the data from the questionnaire, the result of this limited trial conducted to students is presented in Table 2.

According to the overall average percentage, 90.76% of 20 students of chemistry education department claim agree and 9.24% disagree with this Android-based learning media. This indicates that this Android-based learning media is completely ready and feasible to use as learning media because the criterion of students’ response shows more agreement according to the percentage of feasibility test results.

| No | Statement                        | Yes (%) | No (%) |
|----|----------------------------------|---------|--------|
| 1  | Aspect of learning               | 97.5    | 2.5    |
| 2  | Aspect of Material substance     | 100     | 0      |
| 3  | Aspect of visual communication   | 47.5    | 52.5   |
| 4  | Aspect of software engineering   | 98.75   | 1.25   |
|    | Average                          | 97.6    | 2.4    |

In the aspect of learning, 97.5% of the respondents agree and 10% disagree. In the aspect of material substance, 100% of the respondents agree and 60% disagree and it has the highest result of agreement of all. In the aspect of visual communication, 47.5% of the respondents agree and 52.5% disagree and it has the highest result of disagreement of all. In the aspect of software engineering, 98.75% of the respondents agree and 1.25% disagree. The results of this trial prove that the android-based learning media in learning process can promote students’ interest and motivation to learn, shown by the high value in criteria of giving or fostering motivation to learn, contained in the questionnaire. This indicates that multimedia can foster students’ learning motivation. Due to the accommodated needs of students, students will be motivated to continue learning [17].

4. Conclusion

The development stages of android-based chemistry learning media oriented towards generic science skills on the concept of colloids consist of the stage of define, design, and develop. The feasibility test on this android-based chemistry learning media oriented towards generic science skills on the concept of colloids show a valid result with good category, while the students' response to this learning media is included in strong category with a percentage of 90.76%.

References

[1] J Irfansyah 2017 Media Pembelajaran Pengenalan Hewan Untuk Siswa Sekolah Dasar Menggunakan Augmented Reality Berbasis Android J. Inf. Eng. Edu. Technol. 1 1 pp. 9-17
[2] P H Putra 2016 Pengembangan Media Pembelajaran Mobile Game Android Pada Konsep Ikatan Kimia
[3] M A Ramdhani, H Aulawi, A Ikhwana and Y Mauluddin 2017 Model of Green Technology Adaptation in Small and Medium-Sized Tannery Industry J. Eng. Sci. 12 4 pp. 954-962
[4] I Mustaqim 2017 Pengembangan Media Pembelajaran Berbasis Augmented reality J. Edu. Elektro 1 1
[5] F S Irwansyah, I Lubab, M A Ramdhani and I Farida 2017 Designing Interactive Electronic Module in Chemistry Lessons J. Phys: Conference Series 895 1 p. 012009
[6] C Kustandi and S Bambang 2011 Media Pembelajaran Manual dan Digital (Bogor: Ghalia Indonesia)
[7] R Aisyah, I A Zakiyah, I Farida and M A Ramdhani 2017 Learning Crude Oil by Using Scientific
Literacy Comics J. Phys: Conference Series 895 1 p. 012011

[8] I Helsy, Maryamah, I Farida and M A Ramdhani 2017 Volta-Based Cells Materials Chemical Multiple Representation to Improve Ability of Student Representation J. Phys: Conference Series 895 1 p. 012010

[9] S Sari, R Anjani, I Farida and M A Ramdhani 2017 Using Android-Based Educational Game for Learning Colloid Material J. Phys: Conference Series 895 1 p. 012010

[10] F S Irwansyah, Y M Yusuf, I Farida and M A Ramdhani 2018 Augmented Reality (AR) Technology on The Android Operating System in Chemistry Learning IOP Conference Series: Materials Science and Engineering 288 2017 p. 012068

[11] Khasanah 2011 Pengaruh pembelajaran kimia berbasis inkuiri terhadap pemahaman konsep siswa

[12] Y Prasetyo and Irwanto 2015 Utilization effectiveness of chemistry Instructional media to improve self regulated learning and learning outcomes of high school students Proc. Int. Seminar on Chemical Education

[13] Zulfiani 2015 Profil Keterampilan Generik Sains Siswa SMA Pada Model Pembelajaran Inkuiri Terstruktur (Structured Inquiry) Konsep Difusi dan Osmosis (Jakarta: UIN Syarif Hidayatullah)

[14] Brotosiswoyo 2001 Hakikat Pembelajaran MIPA Fisika di Perguruan Tinggi (Jakarta: Pusat Antar Universitas Departemen Pendidikan Nasional)

[15] S Haryati 2012 Research and Development (R&D) Sebagai Salah Satu Model Penelitian dalam Bidang Pendidikan 37 1 pp. 11-26

[16] I S Efrosius 2013 Pengembangan Media Pembelajaran Kimia dengan Materi Pokok Karbohidrat Berbasis Website Sebagai Sumber Belajar Mandiri untuk Siswa SMA/MA p. 16

[17] Y Munadi 2012 Media Pembelajaran Sebuah Pendekatan Baru (Jakarta: Gaung Persada Press) p. 152