The Feasibility of Developing Learning Devices Science Concept Based on Android for College Students in Elementary Teaching Program

Heny Sulistyaningrum[*], Sri Cacik, Anggun Winata, Mualifatul Munawaroh

henysulistyaningrum.65@gmail.com, sricacik.mpd@gmail.com, anggunwinata@gmail.com, mualifatulmunawaroh779@gmail.com

Universitas PGRI Ronggolawe Tuban, Indonesia, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

Abstract. This research is motivated by efforts to improve scientific literacy skills and build the skills of 21st century students by developing the concept of Android-based science learning devices. Learning device are developed so that students can learn independently, quickly, practically, not limited by time and space, and students are ready to compete in the global world. This study aims to describe the feasibility of developing Android-based science learning tools for college students. This device was developed with a 4-D model by Thiagarajan. The tools developed are: RPP, e-book, LKM and evaluation tools. The research subjects were college UNIROW students who took the Science Concept 2018/2019 course. Collecting data using questionnaires and observations, then analyzed using descriptive statistical analysis techniques. From the results of the validation and test results, it can be concluded that the learning tools developed are categorized as good, valid and suitable for use in learning.

Keywords : Feasibility, development, learning device, science concepts, android.

1 Introduction

The urgent need that students must have in order to compete globally in the 21st century is literacy skills. Scientific literacy is an indicator to determine the quality of education and human resources of a country. Scientific literacy is scientific knowledge and skills to identify questions, acquire new knowledge, explain scientific phenomena and draw conclusions based on facts, understand the characteristics of science and technology, shape the environment, nature, intellectuals and culture and the willingness to be involved and care about science-related issues [1].

Scientific literacy skills are related to 21st century skills. The 21st century skills can be cultivated through scientific literacy and science process skills especially for science students [2]. The 21st century skills are formed from an understanding of content knowledge supported by various skills, skills and literacy needed to sustain their success (Patnership for 21st century skills [3]. Stated that 21st century skills consist of critical thinking. and problem solving, creativity and innovation, communication, and collaboration [4].

From the results of a survey of Unirow college students about their early 21st century skills, it was known that the early 21st century skills of Unirow college students were still low. This is indicated by the average critical thinking ability of students less than 30%, creative thinking skills less than 45%, collaborative and communicative skills less than 50%, [5]. This data suggests that Unirow college students do not yet have the 21st century skills as expected.

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

College students as prospective teachers are not ready to teach students with 21st century skills [6]. For this reason, college student teacher candidates need to be developed with 21st century skills so that students can develop ways of thinking and reasoning systematically, logically critically, creative and able to collaborate and communicate. With 21st century skills, it is hoped that college students will have the competence and be able to compete in today's globalization and digital era.

One of the factors supporting the success of learning is the availability and quality of learning resources and media. Based on the results of research [7], the use of learning resources in scientific literacy-based practicum instructions for college Unirow students is not optimal. Students still have difficulty obtaining a theoretical basis in experimentation and learning. An effort to increase learning resources and effective learning media is through digital sources and media. Digital sources and media are very appropriate to be used as alternative solutions to overcome the limitations of learning resources and media faced by students.

Android is a mobile operating system that is currently developing in the midst of other operations[8]. According to [9] android is a comprehensive open source platform designed for mobile devices. At this time, Android-based mobile technology is developing very rapidly. Android applications have a rapid impact on education because through these applications the need to always be connected and learn in many places at an unlimited time [10]. The characteristics of smart education (smart education) are classes that are equipped with the right tools and technology that enable good learning and can facilitate the growing need for knowledge [11].

An effort to improve the quality of learning, scientific literacy skills as well as building the 21st century skills of college students is to develop Android-based science concept learning tools. Android-based science learning devices to build 21st century student skills were developed because at college Unirow there has never been an android-based learning device developed related to 21st century skills. One of the goals of developing learning tools for Android-based science concepts is to improve 21st century skills, and students can learn science concepts easily, quickly, practically, not limited by space and time and students are ready to compete in the global and digital world in the 21st century.

The science concept learning tools developed are the Learning Implementation Plan (RPP), e-books, Student Worksheets (LKM) and evaluation tools. This learning tool was tested on a limited basis for college Unirow students who are currently taking the Science Concept Course in the 2019/2020 academic year. The formulation of the problem in this study is how appropriate is the appropriateness of the Android-based Natural Science Concept learning device for college students? This study aims to describe the feasibility of an Android-based Natural Science learning device for Unirow college students.

2 Methods

The type of research used is Research and Development (R&D). The product developed is an Android-based science learning device for college students consisting of a Learning Implementation Plan (RPP), e-books, Student Worksheets (LKM) and evaluation tools. This research design adapted the 4D (four D) model [12], which consisted of four stages, namely define, design, develop and disseminate. This article only discusses the develop stage which includes expert appraisal and developmental testing.

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

Expert appraisal is a technique for validating or assessing the feasibility of product design by competent experts (validators) in their fields, namely material expert validators, media and learning technology validators and linguist validators. The number of validators for each field of expertise is two people. The validation assessed includes: (1) content validation, (2) construct validation, (3) RPP validation, (4) text book validation (e-book), (5) LKM validation, and (6) evaluation tool validation, (7) validation of observation instruments / assessment of learning management, (8) validation of instruments of lecturer and student activities in learning activities, (9) validation of learning implementation instruments, (10) validation of lecturer response instruments to learning devices, (11) validation of student response instruments learning Media,

Developmental testing is a continuation of the learning device validation test phase, which is the implementation of a trial for the implementation of learning devices to determine the level of practicality and effectiveness of the learning tools that have been made. The trial of learning devices was carried out on a limited basis, namely 12 students of college Unirow Tuban who were taking the Science Concept Course in the 2019/2020 academic year.

The research instrument used was a questionnaire and observation sheet. The questionnaire is used to collect data from the validation results by the validator and the response data of lecturers and students to the development of learning tools. Observation sheets are used to collect observational data on lecturer and student activities in learning, learning management data and assessment of 21st century skills components.

The data analysis technique in this study is to use a percentage descriptive statistical analysis and then interpreted according to the criteria for the level of validity, reliability and effectiveness of the learning tools. To find out the percentage of validity, practicality and effectiveness data, the following formula can be used:

$$score\ percentage = \frac{\sum score\ obtained}{\sum max} \times 100\% \qquad (1)$$

[13]

Then it will be interpreted based on the categories of each data.

2.1 Validity

The calculated validation result data will then be interpreted according to the following table:

Table 1. Criteria for categorizing validity

Score Interval (%)	Category
76 - 100	Very Valid
56 – 75	Valid
40 – 55	Less Valid
0-39	Invalid

Source: Yamasari in [14]

2.2 Practicality

Practicality can be seen from the results of observations of the implementation of the use of learning, namely the observation data of lecturers and students. The data is then analyzed and calculated with the following rums:

➤ $\sum$ is the number of assessments for four meetings obtained by the formula:

$$\sum = \frac{\sum_{i=1}^{n} x_i}{n} \qquad (2)$$

Where,
$\sum_{i=1}^{n} x_i$ = average number of observer ratings

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

n = number of observers.

➤ The average score is the sum of the observers' assessments during the four meetings obtained by the formula:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \tag{3}$$

Where,

$\sum_{i=1}^{n} x_i$ = number of observer ratings

n = number of observers.

➤ Y The average for each category during the teaching and learning activities is obtained from the formula:

$$Y = \frac{\sum_{i=1}^{n} X_i}{n} \tag{4}$$

Where

$\sum_{i=1}^{n} Y_i$: The average number of scores

n : many assessments

➤ Reliability using the formula:

$$Reliabilitas = (\frac{A}{A+D}) x 100\% \tag{5}$$

Where

A : Agrement

D : Disagreement

➤ Average reliability is obtained by the formula:

$$Rata - rata\ Reliabilitas = \frac{\sum_{i=1}^{n} R_i}{n} \tag{6}$$

Where

R : Reliability

n : many meetings.

with categorization criteria as follows:

Table 2. Practical Categorization Criteria

Percentage (%)	Practicality Criteria
$75 \leq p \leq 100$	Very Practical
$50 \leq p < 75$	Practical
$25 \leq p < 50$	Less Practical
$1 \leq p < 25$	Impractical

Source: Yamasari in [14]

2.3 Effectiveness

The effectiveness of learning using the learning tools used can be measured by an increase in learning outcomes and a positive response from users of learning devices, namely lecturers and students. With the following categorization criteria:

Table 3. Criteria for categorization of effectiveness

Percentage (%)	Effectiveness Criteria
$75 \leq p \leq 100$	Very effective
$50 \leq p < 75$	Effective
$25 \leq p < 50$	Less effective
$1 \leq p < 25$	Ineffective

Source: Yamasari in [14]]

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

3 Results and Discussion

3.1 Validation of learning tools

This validity data is obtained from assessments by experts in their respective fields. The experts' assessments are then processed into an average assessment of the experts. The things that are assessed include:

3.1.1 Content validation

The results of the content validation are presented in Table 4.

Table 4. Content validation data tabulation

Assessment Aspects	Average score obtained
Supporting theory	3.53
Syntax	3.8
Social System	3,4
The principle of management reaction	3,7
Support system	3,7
Instructional impact and Accompaniment impact	3.8
Implementation and learning / lectures	3.67
Learning environment and management tasks	3,6
Evaluation	3.5
Average Aspect of assessment	3.63

3.1.2 Construct validation

The results of construct validation are as follows:

Table 5. Validate constructs

Assessment Aspects	The average score obtained
Model components	3,6
Supporting theory	3,9
Syntax	3.53
Social System	3.75
The principle of management reaction	3,9
Support system	3.5
Instructional impact and Accompaniment impact	3,6
Implementation of learning	3.58
Learning environment and management tasks	3.72
Evaluation	3,7
Average Aspect of assessment	3.68

3.1.3 Validation of RPP

The results of the RPP validation are as follows:

Table 6. RPP validation

Assessment Aspects	The average score obtained
Performance criteria	3.67

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

Assessment Aspects	The average score obtained
Contents served	3.78
Language	3.67
Time	3,4
The serving method	3.89
Closing	3,9
Average Aspect of assessment	3.72

3.1.4 Textbook validation (e-book)

The results of the textbook validation (e-book) are as follows:

Table 7. E-book validation

Assessment Aspects	The average score obtained
Sub Concept Organization	3.82
The description according to the steps of cooperative learning based on Android	3.63
Activity	3.93
Closing	3,7
Average Aspect of assessment	3.77

3.1.5   MFI Validation

The results of the LKM validation are as follows

Table 8. MFI Validation

Assessment Aspects	Average score obtained
MFI organization	3.8
Procedure	3.72
Questions / problems	3.86
Average Aspect of assessment	3.79

3.1.6 Validation of evaluation tools

The results of the evaluation tool validation are as follows

Table 9. Validation of evaluation tools

Assessment Aspects	Average score obtained
Theory	3.5
Construction	3,6
Language	3,4
Average Aspect of assessment	3.5

3.1.7 Validation of research instruments

The results of the validator's assessment of the instrument: observations of learning management, learning implementation, lecturer responses to learning devices, student responses to learning tools and 21st century skills assessment were all declared valid without revision. For the instrument of observing the activities of lecturers and students, they get a valid assessment with a few revisions, namely revisions to typing errors and adding components to give rewards to lecturer activities and adding to receiving rewards in student activity components.

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

Furthermore, the tabulation of the average rating of the experts based on the validation assessment category can be seen in Figure 1.
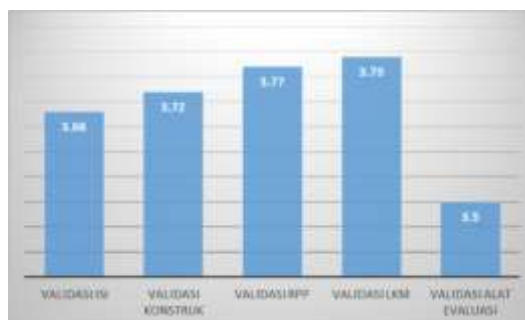
Figure 1. Data tabulation diagram of the validity of the Android-based science learning device

Based on the interpretation of the validity data used to determine the validity of the learning device based on the Android-based Natural Science concept, it is known that the average result of the expert's assessment is 3.7 or 92.5% in accordance with the validity criteria table, it is categorized as valid.

3.2 Practicality
The practicality of learning devices can be seen from the practicality of learning information using the learning tools that have been developed. From the results of the trial implementation of the learning process, the reliability of the observation instruments used can also be measured. Practicality assessments include:

3.2.1 Learning Assessment
The implementation of learning here is learning that focuses on using small groups of students to work together, which includes:

3.2.1.1 Lecturer and student activities
The activities of lecturers and students in learning using the Android-based science concept learning device are presented in Table 8.

Table 10. Tabulation of data on the results of lecturer and student activities in learning

Meeting	Percentage of Lecturer Activities
1	86
2	90
3	90
4	94
Average	90

3.2.1.2 Management of learning
Learning management data is presented on Table 9

Table 11. Tabulation of learning management result data

Aspects of assessment	Average score
Introduction	3.5

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

Brownsing / Related Material Discovery	2.9
Communication	3,3
Problem Solving And Presentation	3,4
Presentation of Summary (Summary)	3,1
Question and Response Phase (Closing)	3,4
Time Management	3.5
Observing Classroom Atmosphere	3,6
Average	3,4

3.2.2 Instrument Reliability

The reliability of the instruments is presented in Table 10.

Table 12. Tabulate instrument reliability data

Assessment Aspects	The average score obtained
Lecturer and Student Activities	88.30%
Learning Management	92.82%
Aspects of critical thinking	93.75%
Aspects of creative thinking	92.36%
Collaborative Aspect	92%
Communicative Aspects	88.19%
Percentage Average	91.24%

Based on the interpretation of the practicality data used to determine the practicality of the learning tools based on the Android-based science concept, it is known that the average result of the assessment of learning implementation is 3.2 or 80% in accordance with the practical criteria table, it is categorized as practical. Then for reliability with a high percentage of 91.24%, so it can be concluded that the Android-based Science Concept learning device is said to be practical.

3.3 Effectiveness

The effectiveness of learning tools can be seen from the data analysis used to measure the effectiveness of learning tools, which include:

3.3.1 Aspects of critical thinking

The average score of critical thinking aspects is presented in Table 13.

Table 13. Tabulation of data from the assessment of critical thinking aspects

Assessment Aspects	Average score
Interpretation	2.97
Analysis	3.09
Evaluation	3.24
Inference	3.17
Average	3.12

Based on the results of the critical thinking aspect, it is stated to have a good category and high reliability (93.75). These results are also in accordance with the results of research [15], namely that the application of Android-based learning can improve critical thinking skills.

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

3.3.2 Aspects of creative thinking

The average score for the aspects of creative thinking is presented in Table 14.

Table 14. Tabulation of data on the assessment of creative thinking aspects

Aspects of assessment	Average score
Fluency	3.14
Flexibility	3.02
Novelty	3.35
Average	3.20

3.3.3 Collaborative aspect

The average score for the collaborative aspects is presented in Table 15.

Table 15. Tabulation of the collaborative aspect of the assessment results

Aspects of assessment	Average score
Group collaboration	3
Cooperation between groups	3
Synergy	3
Empathy	3
Appreciate different perspectives	3
Adaptation in roles of responsibility	3
Average	3

3.3.4 Communication aspect

The average score for the communication aspect is presented in Table 16.

Table 16. Data tabulation of assessment results aspects of communication

Aspects of assessment	Average score
Clear speech / language	3
Speak firmly, and not be circumspect	3
Polite in communicating and behaving	3
Body gestures according to the subject matter and the situation conditions	3
The flow of systematic ideas	3
Communicative	3
Average	3

For the average assessment of the effectiveness of learning tools, it can be seen in Figure 2.To clarify the assessment of each aspect for assessing the effectiveness of learning tools for four meetings, it can be seen in Figure 3.

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

Figure 2. The diagram of the average data tabulation of the assessment of skills for learning devices for learning science concepts based on Android
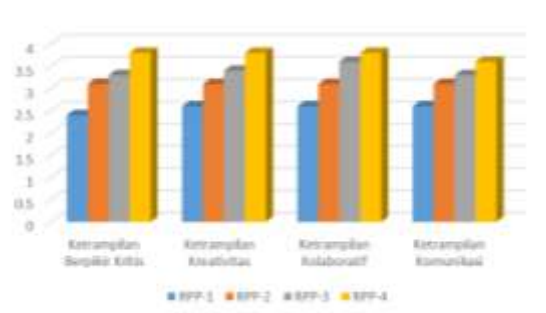
Figure 3. Data tabulation diagram for four meetings for the assessment of skills of learning tools for learning science concepts based on Android

Based on Figure 3, it can be seen that there has been an increase at each meeting. So that the average of each aspect of the assessment is obtained, namely, the average results of the assessment of critical thinking skills are 3.15; the average results of the assessment of creativity skills 3.23; The average collaborative skills assessment results are 3.28 and the average communication skills assessment results are 3.15. Then the average result of the assessment of these four aspects is 3.2 and then interpreted into the following table the interpretation of the effectiveness data used to determine the effectiveness of the Android-based science learning device. The Android-based science concept shows that the average result of the learning assessment is 3, 2 or with a percentage of 80% and questionnaire assessment of the responses of lecturers and students, the average percentage was 87.86%. The total average is obtained with a percentage of 84%. Based on the interpretation of the effectiveness category table, it can be concluded that the Android-based Science Concept learning device is said to be effective.

4 Conclusion

The type of research used is Research and Development (R&D). The product developed is an Android-based science learning device for college students, consisting of a Learning Implementation Plan (RPP), e-books, Student Worksheets (LKM) and evaluation tools. This

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

research design adapted the 4D (four D) model, which consisted of four stages, namely define, design, develop and disseminate. The average percentage of validity data is 92.5% which is said to be very valid, the average percentage of practicality data is 80% which is said to be very practical, and the average percentage data of effectiveness is 84% which is said to be very effective. Thus from this research it can be concluded that the learning tools that have been developed are feasible to use.

Acknowledgments

References

[1] O. PISA, "Results in Focus, PISA in Focus, no. 67." OECD Publishing, Paris (2016). https://doi. org/10.1787/aa9237e6-en, 2015.

[2] P. Turiman, J. Omar, A. M. Daud, and K. Osman, "Fostering the 21st century skills through scientific literacy and science process skills," *Procedia-Social Behav. Sci.*, vol. 59, pp. 110–116, 2012.

[3] F. Dewi, "Proyek Buku Digital: Upaya Peningkatan Keterampilan Abad 21 Calon Guru Sekolah Dasar Melalui Model Pembelajaran Berbasis Proyek," *Metod. Didakt. J. Pendidik. Ke-SD-An*, vol. 9, no. 2, 2015.

[4] L. Kemdikbud, "Kurikulum 2013: Pergeseran paradigma belajar abad-21," *Jakarta, Juni*, 2013.

[5] H. Sulistyaningrum, A. Winata, and S. Cacik, "Analisis Kemampuan Awal 21st Century Skills Mahasiswa Calon Guru SD," *J. Pendidik. Dasar Nusant.*, vol. 5, no. 1, pp. 142–158, 2019.

[6] H. Sulistyaningrum, A. Winata, and S. Cacik, "ANALISIS D1 PENGEMBANGAN PERANGKAT PEMBELAJARAN KONSEP IPA BERBASIS ANDROID UNTUK MEMBANGUN 21st CENTURY SKILLS MAHASISWA," *Pros. SNasPPM*, vol. 4, no. 1, pp. 10–15, 2019.

[7] A. Winata, S. Cacik, and I. S. RW, "Analisis Kemampuan Awal Literasi Sains Mahasiswa Pada Konsep IPA," *Educ. Hum. Dev. J.*, vol. 1, no. 1, 2016.

[8] H. Sulistyaningrum, A. Winata, and S. Cacik, "VALIDASI PERANGKAT PEMBELAJARAN KONSEP IPA BERBASIS ANDROID UNTUK MEMBANGUN 21st CENTURY SKILLS MAHASISWA," *Pros. SNasPPM*, vol. 5, no. 1, pp. 61–67, 2020.

[9] M. Bousmah, O. Labouidya, and N. El Kamoun, "MORAVIG: An Android Agent for the Project Mobile e-Learning Session," *Int. J. Comput. Appl.*, vol. 113, no. 15, 2015.

[10] L. Serafimov, "Mobile learning platforms," in *Conference proceedings of»*

Procedia of Social Sciences and Humanities

Proceding of the International Conference on Intellectuals' Global Responsibility 2020 (ICIGR):
Science for Handling the Effects of Covid-19, Facing the New Normal, and Improving Public Welfare

eLearning and Software for Education «(eLSE), 2013, no. 02, pp. 194–199.

[11] E. R. Sykes, "New methods of mobile computing: From smartphones to smart education," *TechTrends*, vol. 58, no. 3, pp. 26–37, 2014.

[12] S. Thiagarajan, "Instructional development for training teachers of exceptional children: A sourcebook.," 1974.

[13] R. Darmawan, "Skala Pengukuran Variabel-Variabel Penelitian," *Bandung Alf. Hal*, vol. 24, 2008.

[14] M. Munawaroh and H. Sulistyaningrum, "PENGEMBANGAN KOMIK MATEMATIKA BTVH UNTUK SISWA KELAS VIII SMP," *J. Teladan J. Ilmu Pendidik. Dan Pembelajaran*, vol. 4, no. 2, pp. 127–134, 2019.

[15] A. Winata, H. Sulistyaningrum, and S. Cacik, "Peningkatan Kemampuan Berpikir Kritis Mahasiswa Menggunakan Pembelajaran Berbasis Android Pada Matakuliah Konsep IPA," *EduStream J. Pendidik. Dasar*, vol. 3, no. 2, pp. 1–9, 2019.