Advances in Social Science, Education and Humanities Research, volume 491
Proceedings of the International Joint Conference on Arts and Humanities (IJCAH 2020)

Development of Mobile Learning Application Based on Sociotechnology Approaches in Electrolyte and Nonelectrolyte Solutions

Ucu Cahyana[1,*] Afrizal[1,] Indah Safitri[1]

[1] *Department of Chemistry Education, Faculty of Mathematics and Natural Sciences, State University of Jakarta, Jakarta 13220, Indonesia*
[*] *Corresponding author. Email: u.cahyana@yahoo.com*

ABSTRACT
This study aims to develop mobile learning app based on a sociotechnology approaches on Electrolyte dan Nonelectrolyte Solutions and to know the feasibility of media produced. Mobile learning was tested at SMAN 1 Serang Baru Bekasi and SMAN 11 Bekasi from January to Mei 2020. The research method used is Research and Development (Borg and Gall) through five stages, namely: needs analysis, product development, validation, and product test. The resulting mobile learning media app is called "Electrolyte.apk" which provides a summary, videos, simulations, quizzes, and educational games. Mobile learning media is competible on Android devices. Feasibility test by topic and language expert acquired 87% with 0.967 of reliability. Feasibility test by media experts acquired 80% with 0.729 of reliability. Assesment Media trials by Chemistry teachers acquired 82% with "very good" criteria. Media trials by small scale students acquired 80% with "good" criteria. Media trials by large scale acquired 82% with "very good" criteria. Based on the results can be concluded that mobile learning media based on sosiotechnology in Electrolyte Solutions topic proper to use as a learning media and suitable for students and teachers needed.

Keywords: *Mobile learning, Sociotechnology approaches, Electrolyte and nonelectrolyte solution*

1. INTRODUCTION

Currently, it is important to link theory to natural phenomena in everyday life. this becomes very important, so that the theory can be accepted properly and easily. Chemistry is a science that continues to grow and develop. Chemistry learning can be obtained through learning that relates theory to symptoms in everyday life [1]. The many chemical concepts that must be understood by students with relatively limited time cause students to experience difficulties in learning chemical concepts. In the learning process also sometimes less than the maximum in associating theory with daily life so that learning becomes ineffective and inefficient [2].

In general, learning chemistry in high school / MA emphasizes more on aspects of knowledge and understanding of concepts only. This causes the ability to develop reasoning ability in solving problems owned by students to be limited. Limitations that occur will produce students who are passive, less skilled in critical thinking, and less communicative [3]. Students' critical thinking skills can be improved by effective learning processes and linking theory with symptoms that occur in everyday life. One alternative that can be done is to use interactive learning media and can clearly describe electrolyte and non-electrolyte material. The learning media applied are adapted to the conditions of rapid technological progress so that it also impacts the educational environment. Cellular technology became one form of technological development in the 4.0 revolution.

Mobile devices can support variations in learning methods in the classroom if designed according to needs [4]. Mobile learning media is able to connect between individuals, find information, learn with flexible time, and collaborate between science and phenomena that occur. This can increase the interest and enthusiasm of students with attractive displays [5]. Mobile learning media is one of the learning media that refers to the use of digital information technology devices in the learning process [6]. The use of mobile app in learning can be used to develop students' skills because mobile app is a medium that can realize interactive and flexible learning,

mobile learning can be accessed wherever students are. This can encourage students to produce meaningful learning [7]. Mobile learing app can describe the problem clearly and make students well disguised by the phenomena that occur so as to solve the problem scientifically and be able to improve communication skills and cooperation between students [8].

As for the weaknesses of the use of cellular technology in the learning process, in general students will focus on their respective mobile devices and make individualism. This makes researchers develop mobile learning media based on the sociotechnology approach. The sociotechnology approach is a process of interaction between humans and humans with technology to maintain social behavior in society and can integrate social situations in the use of technology [9]. Integrating the sociotechnology approach in mobile learning is expected to make students interact with technology, peers, and teachers and can get material descriptions of electrolyte and non-electrolyte solutions effectively, efficiently, and easily understood. The main material that will be discussed in this research is electrolyte and non-electrolyte material because electrolyte and non-electrolyte material in the 2013 revised curriculum. This material has several characteristics including the concept of matter is difficult to describe, especially in the theory of ions according to Svante Archenius who said that the decomposition of a solution into ions will conduct electricity. Then, the application of concepts in identifying strong electrolytes, weak electrolytes, and non-electrolytes and their applications in daily life also becomes abstract learning for students. This is supported by the result of the student and teacher needs analysis questionnaire. As many as 60% of the students from the total respondents were 68 students and as many as 57% of the total respondents were 7 teachers who expressed difficulty describing Electrolyte and Non-Electrolyte material.

2. METHOD

This research uses the Research and Development method which is a method that aims to develop and improve the quality of education by creating the latest innovations in the form of learning media products to help the learning process [10]. According to Brog and Gall there are 10 stages of specific product development research and testing the feasibility and effectiveness of the product when implemented, namely: information gathering, planning, product development, field trials (main field testing), initial product revisions (operational product revisions), final product revisions (final product revisions), field trials (operational field testing), dissemination (dissemination).

3. RESULT AND DISCUSSION

3.1. Analysis Result and Needs

The result of the needs analysisi were then produced as a percentage. 95% of student said that the solution of electrolytes and non-electrolytes is a material that is difficult to understand. As many as 25% of students stated the difficulty factor because the material was too abstract, 60% of students stated it was because of too many memorization, and 10% of students stated that there were many calculations. As many as 84% of students use Android-based smart phones and 98% of students agree to develop an Android-based learning media that contains a summary of electrolyte and non-electrolyte solution materials.

Based on the results of teacher analysis, the teacher said that learning media is needed to assist in the delivery of material. Expected learning media can contain material summaries, picture descriptions, learning videos, and educational quizzes. Therefore, all teachers agree that mobile learning media can be developed as learning media that can help the learning process be more interactive and easy to understand.

3.2. Mobile App Media Development

Phase Design mobile learning media, create story boards, choose software to develop media, and create mobile learning media. Mobile learning media are developed according to the needs of teachers and students and are adjusted to basic competencies in the material electrolyte and non-electrolyte solution. After that, storyboards are made to simplify the development process in order to find out the flow of the media to be developed in a structured and systematic way. The software used is Adobe Flash CS6 with a programming language using scripts, while the software used to make learning videos is Wondershare Filmora 9 and create image designs and animations using Canva software program media.

3.3. Mobile Learning Media

Testing Phase The media trials were conducted by three media experts, three material and language experts, teachers and students on a large and small scale. The aspects tested in the due diligence by media experts are 1) Audio and visual display and 2) Implementation and software engineering. The results of the final assessment of experts on these two aspects can be seen in Table 1. Based on the results of media trials by media experts, the overall aspect percentage is 80% with good criteria.

Table 1. Validation test by media experts

No	Aspect	Item	Percentage of Feasibility	Criteria
1	Audio and visual	1-8	83%	Very Good
2	Software and engineering	9 - 13	77%	Good
Average Overall Rating			80%	Good

Based on the data obtained, the reliability calculation is done through the Hoyt Test formula. Calculation of reliability using SPSS software, this calculation aims to see the consistency of opinions of each expert. The result of media reliability was 0.729 and classified the criteria of "Good". This result shows the consistency of the assessment results and the quality of the developed mobile learning media. The aspects tested in the feasibility test of material and language are 1) Relevance of the substance of the content with the competencies that must be achieved, 2) Questions, and 3) Language. The results of the final assessment of the material and language feasibility test can be seen in Table 2. Based on the results of the material and language trial by the material and language expert the overall aspect percentage is 87% with very good criteria.

Table 2. Validation test by materials and language experts

No	Aspect	Item	Percentage of Feasibility	Criteria
1	The relevance of the substance of the content to the competencies that must be achieved by students	1-2	88%	Very Good
2	Question	3-9	85%	Very Good
3	Language	10-11	88%	Very Good
Average Overall Rating			87%	Very Good

The reliability test results from the material and language feasibility test were 0.967 and classified "Very Good" criteria. These results indicate the consistency of the results of the assessment and the quality of the material and language used in the mobile learning media that were developed very feasible. After the media is said to be feasible based on the feasibility test by the expert, the next is a media trial for small scale students. Respondents in the small-scale media test were 20 students of SMAN 1 Serang Baru Bekasi. The aspects tested were quality of material, experiments, questions, discussion, audio and visual display, software implementation and engineering, utilization, and the relevance of media content to the sociotechnology approach. Based on the results of small-scale tests by students, the average percentage of all aspects is 80% with the criteria of "Good". The results of small-scale tests by students can be seen in Table 3.

Table 3. Small scale trial result by students

No	Aspect	Item	Percentage of Feasibility	Criteria
1	Question	1 - 5	83%	Very Good
2	Langua-ge	6 - 7	78%	Good
3	Software and engineer-ing	8 - 15	80%	Good
4	Impleme-ntation	16-23	79%	Good
Average Overall Rating			80%	Good

Then, testing the mobile learning media on a large scale is conducted. Respondents in the large-scale test were 60 students of SMAN 11 Bekasi. The aspects tested were quality of material, experiments, questions, discussion, audio and visual display, implementation and software, utilization, and relevance of the substance of media content with the sociotechnology approach. Based on the results of large-scale tests by students, the percentage of all aspects is 82% with the criteria of "Very Good". The results of large-scale tests by students can be seen in Table 4.

Subsequent research was conducted by media testing by the teacher. The respondents in the media trial by the teacher were six chemistry teachers. The aspects tested are 1) the suitability of the substance of the content with the competence, 2) the quality of the material, experiments, 3) questions, 4) language, 5) audio-visual display, 6) implementation and software engineering, utilization, 7) relevance of content substance media with a sociotechnology approach. Based on the results of teacher trials, the average percentage of all aspects is 82% with the criteria "Very Good". The results of trials by teachers can be seen in Table 5.

Table 4. Small scale trial result by students

No	Aspect	Item	Percentage of Feasibility	Criteria
1	Question	1 - 5	81%	Very Good
2	Language	6 - 7	82%	Very Good
3	Software and engineer-ing	8 - 15	84%	Very Good
4	Implement ation	16-23	79%	Good
Average Overall Rating			82%	Very Good

Based on trials conducted by teachers and students, mobile learning media can be declared feasible with the criteria of "Very Good". So that mobile learning media is feasible to be used and used as a learning aid and alternative tools in reducing the level of difficulty of students in understanding the material [11].

Mobile learning is one of the media that can deliver learning material based on the use of handheld information and communication technology, which is now called smartphone [12]. Testing the feasibility of mobile learning media based on the sociotechnology approach refers to the calculation of the Likert scale which has several analytical techniques namely compiling and collecting questionnaires from respondents in this study who are media experts, linguists, material experts, teachers, and students. Then the data obtained is processed and calculated to get a percentage in each of its categories [13].

Mobile learning based on a sociotechnology approach presents features needed in the learning process such as a summary of the material, video demonstrations, educational quizzes, and student worksheets. In general, sociotechnology is a science approach that refers to the development of technology and humanity. This approach has the role of transforming individuals in the relationship between individuals and technology so that they become skilled individuals who think critically, creatively, and innovatively [14]. Sociotechnology is a learning tool that links the social environment with technology [15]. In a school environment, it can be applied by linking students, teachers, and technology.

Table 5. Media trials by the teachers

No	Aspect	Item	Percentage of Feasibility	Criteria
1	The relevance of content substance to basic competen-cies, material, and the relevance of content substance to the sociotech-nology approach	1 - 4	81%	Very Good
2	Question	5 – 6	81%	Very Good
3	Language	7 - 14	82%	Very Good
4	Implement ation and software and engineer-ing	15 - 19	80%	Very Good
	Advantege	20	88%	Very Good
Average Overall Rating			82%	Very Good

Keengwe & Bhargava (2013) states that technology has a strong potential to shift the conventional learning process into a modern one [16]. Technology can be designed and implemented and linked to relevant concepts, this will result in modern learning and create a highly interactive, effective and efficient learning process. The sociotechnology approach has the advantage of being able to make the learning process that can divide the role between individuals and individuals, individuals with technology, and individuals with the surrounding environment [17].

This indicates that sociotechnology-based mobile learning has a positive effect on the development of students' reasoning because in mobile learning natural phenomena are associated with electrolyte and non-electrolyte solution materials. In accordance with

research on reasoning it is stated that the reasoning of students can be significantly improved if the learning process is structured, interactive, and the use of teaching materials can stimulate reasoning [18].

Based on the results of the overall feasibility test it can be seen that the media of mobile learning based on sociotechnology approach has a very good feasibility and can meet the needs of teachers and students in the learning process. Mobile learning is one of the learning media that refers to the use of digital information technology devices in the learning process [6]. Mobile learning media will make individuals actively participate and develop social relationships in their environment [19]. In the learning process, this will make educators and students form a self-identity that can survive the development of the 21st century [20].

Sociotechnology-based mobile learning can be an alternative in overcoming difficulties in describing a material, especially electrolyte and non-electrolyte material. The sociotechnology approach makes interaction between teachers, students, technology, and the environment resulting in an interactive and innovative learning process and develops students' critical thinking skills [21]. There is a positive correlation between the use of educational technology and the involvement of learners especially in collaborative learning methods [4]. The limitations of mobile learning that are applied in learning are, limited internal memory for data storage processes, limited ability of the processor to input features available in mobile learning, and limited battery power on the device [22]. Thus, the development of mobile learning media based on a sociotechnology approach can be one of the effective, interactive, and innovative teaching materials on electrolyte and non-electrolyte solution materials in class X students.

4. CONCLUSION

Mobile learning media based on the sociotechnology approach to the material electrolyte and non-electrolyte solutions can be learning aids in schools. Mobile learning media has been successfully developed with various stages of research. The mobile learning media developed is named Electrolyte.apk which is compatible on smartphone devices with the Android operating system.

The developed mobile learning media contains a summary of material, learning videos, LKPD (Student Worksheet), and educational quizzes.

Mobile learning media based on a sociotechnology approach to electrolyte and non-electrolyte material developed by researchers is in accordance with the needs of teachers and students, has the feasibility to be used as a learning medium to facilitate students in understanding electrolyte and non-electrolyte material.

REFERENCES

[1] E. T. Pramesti, R. B. Rudibyani, and E. Sofia, "Pengembangan LKS Larutan Elektrolit dan Non Elektrolit Berbasis Problem Solving," vol. 6, no. 1, pp. 86–100, 2017.

[2] R. H. Ristanto, R. Djamahar, E. Heryanti, and I. Z. Ichsan, "Enhancing Students ' Biology-Critical Thinking Skill through CIRC-Based Scientific Approach (Cirsa)," no. April, 2020.

[3] H. Patmawati, "Program Studi Pendidikan Kimia 1432 H / 2011 M," Universitas Negeri Syarif Hidayatullah, Jakarta, 2011.

[4] L. Amhag, "Student Reflections and Self-Assessments in Vocational Training Supported by a Mobile Learning Hub," vol. 12, no. 1, pp. 1–16, 2020.

[5] D. Maor, "Hospitalized Adolescents ' Use of Mobile Technologies for Learning , Communication , and," 2018.

[6] D. G. Mugo, K. Njagi, and B. Chemwei, "Technological Preferences , Levels of Utilization and Attitude of Students Towards Mobile Learning Technologies in Chartered Universities , Kenya," *Int. J. Educ. Lit. Stud.*, no. c, pp. 98–110, 2017.

[7] Z. Sun, X. Yao, J. You, W. Du, L. Luo, and Z. Sun, "Detecting the correlation between mobile learning behavior and personal characteristics among elementary school students," *Interact. Learn. Environ.*, vol. 0, no. 0, pp. 1–16, 2018.

[8] O. Barden, "Literacy Building the Mobile Hub : Mobile Literacies and the Construction of a Complex Academic Text," *Mob. literacies a complex Acad. text*, vol. 00, no. 00, pp. 1–8, 2018.

[9] L. A. Pasquini, "Sociotechnical stewardship in higher education : a field study of social media policy documents," *J. Comput. High. Educ.*, 2016.

[10] T. Amiel and T. Reeves, "Design-Based Research and Educational Technology : Rethinking Technology and the Research Agenda," *Educ. Technol. Soc.*, vol. 11(4), pp. 29–40, 2008.

[11] W. Purnama Sari and D. Ratna Ma'rifah, "Pengembangan LKPD Mobile Learning Berbasis Android dengan PBL untuk Meningkatkan Critical Thinking Materi Lingkungan," *J. Pendidik. Biol.*, vol. 11, pp. 49–58, 2020.

[12] D. Morrison and M. Koole, "Learning On-The-Go : Older Adults ' Use of Mobile Devices to Enhance Self-Directed , Informal Learning," vol. 29, pp. 423–443, 2018.

[13] H. Haviyani, I. Farida, and I. Helsy, "Pengembangan Bahan Ajar Pada Materi Sel Volta Berorientasi Multipel Representasi Kimia," *Simp. Nas. Inov. Pembelajaran Sains*, vol. 2015, no. ISBN: 978-602-19655-8-0, pp. 357–360, 2015.

[14] S. Anggiat and S. Hadiati, *Pemberdayaan Sumber Daya Manusia*. Jakarta: Lembaga AdministarsiNegara Republik Indonesia, 2001.

[15] J. G. Watson and S. J. Derry, "Proceedings of The Human Factors And Ergonomics Society 43rd Annual Meeting," pp. 539–542, 2015.

[16] M. Keengwe, J. and Bhargava, "Mobile Learning and Integration of Mobile Technologies in Education," 2013.

[17] J.-R. Ruault, F. Vanderhaegen, and D. Luzeaux, "Sociotechnical systems resilience," 2012.

[18] K. Thamwipat, P. Princhankol, and N. Deeyen, "The Development of Multimedia and Activities to Promote Products Made by State Enterprise Communities in the Bangmod Project 4 . 0 Through Community-Based Learning," vol. 12, no. 4, pp. 49–59, 2019.

[19] I. Talmi, O. Hazzan, and R. Katz, "Intrinsic Motivation and 21st-Century Skills in an Undergraduate Engineering Project : The Formula Student Project," vol. 8, no. 4, pp. 46–58, 2018.

[20] A. Butterfield and K. J. Branch, *Collaboration between Seniors and Freshmen on Senior Capstone Project*. LA: New Orleans, 2016.

[21] N. Law, "Sociotechnical co-evolution of an e-Learning innovation network," vol. 0, no. 0, pp. 1–14, 2019.

[22] C. Lai, "Trends of mobile learning: A review of the top 100 highly cited papers," vol.0, no.0, 2019.

APPENDICES

Figure 1. Display the start page of the media	Figure 2. Display the main menu page	Figure 3. Display the main menu summary

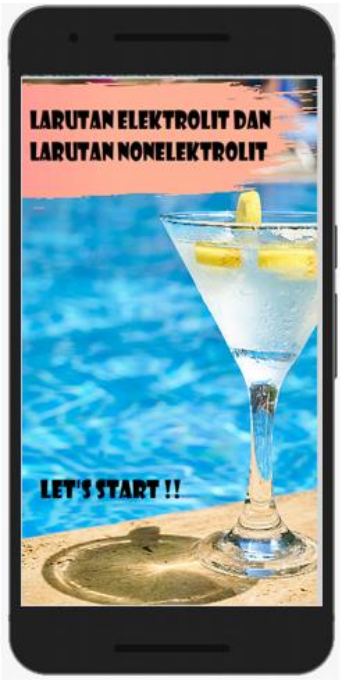
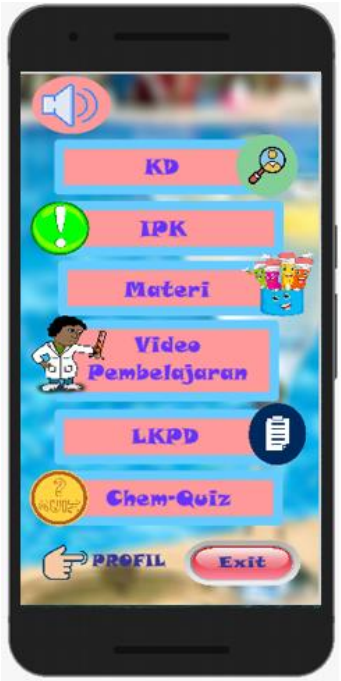
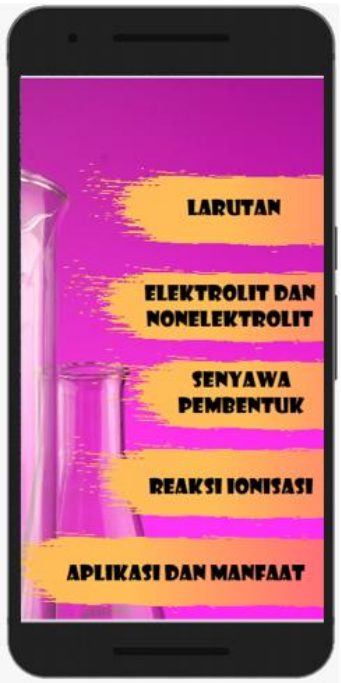

		

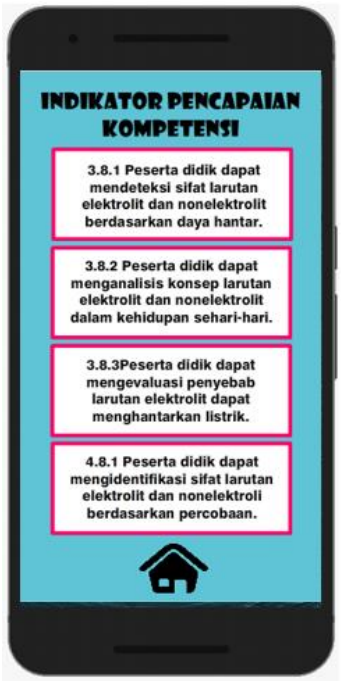
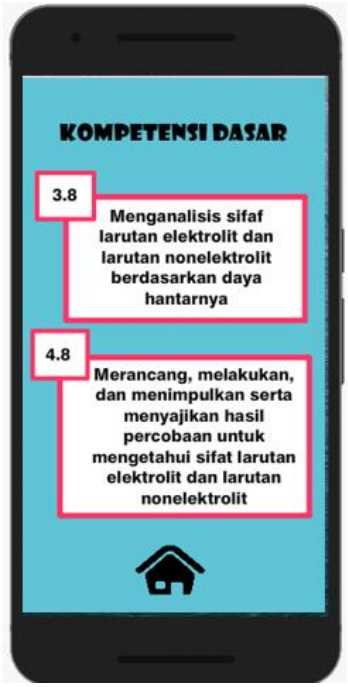
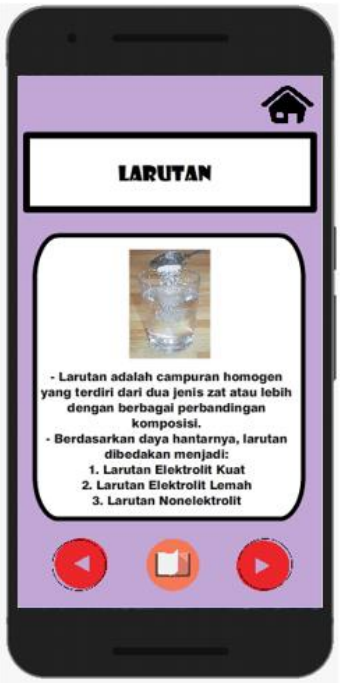
Figure 4. Display KD	**Figure 5. Display Indicators**	**Figure 6. Display Material**
		

Figure 31. Display Student Worksheet	Figure 32. Display Student Worksheet	Figure 33. Display Student Worksheet

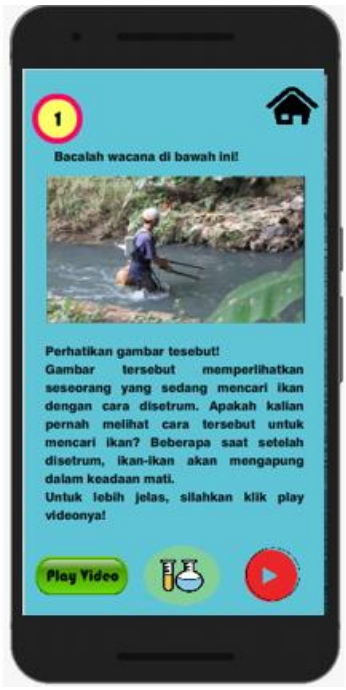
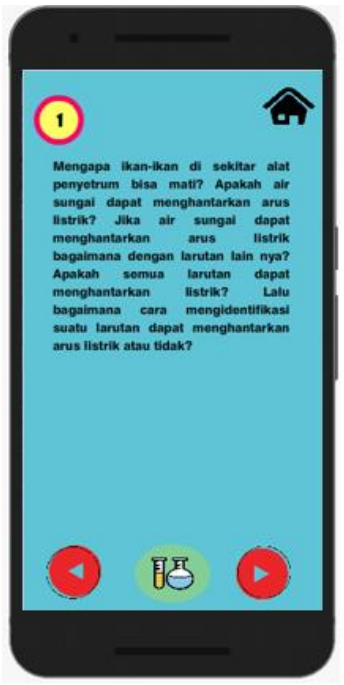
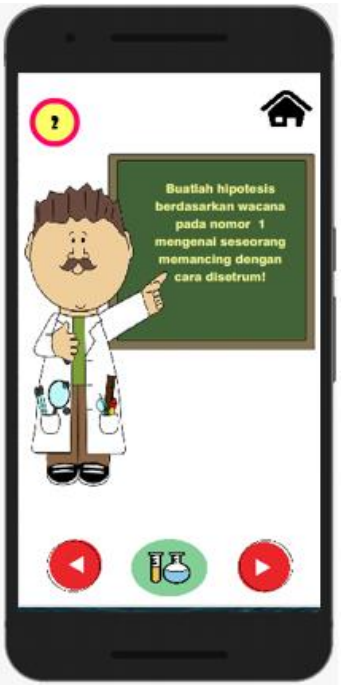

		

Figure 46. Display Games	**Figure 47. Display Experiment Video**	**Figure 48. Display Information**