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Validity of Scientific Based Chemistry Android Module to Empower Science Process Skills (SPS) in Solubility Equilibrium

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Abstract. Evolution of Android technology can be applied to chemistry learning, one of the complex chemistry concept was solubility equilibrium. This concept required the science process skills (SPS). This study aims to: 1) Characteristic scientific based chemistry Android module to empowering SPS, and 2) Validity of the module based on content validity and feasibility test. This research uses a Research and Development approach (RnD). Research subjects were 135 students and three teachers at three high schools in Boyolali, Central of Java. Content validity of the module was tested by seven experts using Aiken’s V technique, and the module feasibility was tested to students and teachers in each school. Characteristics of chemistry module can be accessed using the Android device. The result of validation of the module contents got V = 0.89 (Valid), and the results of the feasibility test obtained 81.63% (by the student) and 73.98% (by the teacher) indicates this module got good criteria.

1. Introduction
The development of information and communication technology has grown quickly. In effect, each person always depends on the use of technology. Today, information technology and communications, cover most aspects of life [2], one of which is education [1]. One of its application is the creation of smartphone. Everyone nowadays most has a smartphone to facilitate its work [3]. Smartphones are smart communication tools that are not only used for the call but also includes a feature to read, write, draw, send, find locations, search for information in a virtual media [4]. In fact, things that previously only be run through a desktop computer can now be run through a smartphone [5]. One of the popular open source used by the public is Android. Android is a Linux-based operating system designed for smartphones to run mobile apps to facilitate the work [6]. To that end, it is not impossible that smartphone technology needs to be applied in the field of education. Not only used to run social media applications and games but also run education applications that are useful for improving student achievement in school. In addition, this time teachers need to be more creative in developing instructional media.

Chemistry is one of the learning subjects in high school. Chemistry is one of the subjects that need help visualization/simulation to explain the concept. Most of the chemical lesson was abstract (microscopic level) where the concept cannot be observed by eye and is expressed in the form of molecules, ions, and atoms [7]. Based on the questionnaire introduction and observation in SMA 3 Boyolali, SMAN 1 Teras, and SMAN 1 Kemusu exemplify several results as follows.
a. Learning chemistry in those schools is still dominated by teacher-centered, students has yet to be active in class;
b. One chemistry course is quite difficult for students and requires visual media, especially for solubility equilibrium concept;
c. Students is allowed to use gadget for learning support;
d. Teachers use textbook in teaching, although there are many limitations; and
e. One of the best methods for teaching the solubility equilibrium concept is the laboratory experiments using scientific approach, but it takes more time.

Based on such results, it is concluded that the implementation of mobile apps android concerning chemical subjects can be applied by the teacher because it can serve not only writing, but also playing videos, music, and animation. Hence, due to those features simulation chemistry lab using android can be a solution for teachers about the lack of time to conduct experiments in a real lab. Moreover, subject solubility equilibrium is a learning material that requires a scientific approach (observing, asking, collecting data, analyzing, and communicating). It then requires a systematic android app to guide students to be more active in leveraging its science process skills. Science process skills were skills that arise from scientific activities that simplify the science of learning, enabling students to develop a sense of responsibility in their own learning, improve learning provision, as well as teach them the methods of research [8]. Based on these problems, the researcher develops Scientific-based Chemistry Android Module to Empower Science Process Skills (SPS) in Solubility Equilibrium Concept.

2. Method
This study used Research and Development approach (RnD) consisting of 9 of 10 stages, namely 1) Information collecting, 2) planning, 3) develop a preliminary form of products, 4) preliminary field testing, 5) main product revision, 6) main field testing, 7) operational product revision, 8) operational field testing and 9) final product revision. Participants were 135 students and 3 teachers of SMAN 3 Boyolali, SMAN 1 Teras, and SMAN 1 Kemusu, Boyolali, Central of Java, Indonesia. Content validity of the module was tested by seven experts using Aiken's V technique, and the module feasibility was tested to students and teachers in each school.

3. Result and Discussion

3.1. Product Development
Based on the problems obtained during the preliminary research it is concluded that one of the solutions is to develop a teaching media based on scientific process because it can make chemistry more visible, be a solution to the lack of time in practical activities and empower science process skills in solubility equilibrium. Hence, researchers develop scientific-based android modules to empower science process skills in solubility equilibrium concept.

This module, based on scientific process, includes activities that can bring scientific attitudes of students. It is also adjusted to the approach needs for applying the latest curriculum. This module forms mobile apps because it can load explanation accompanying video, animation and moving images for easy visualization of a chemical that cannot be given in the form of the print module. This module also features interactive animations chemistry lab; it can facilitate teachers who lack time to carry out practical work in the classroom. If the lab in the classroom/laboratory should be completed in the middle of learning progress, the students can continue in the simulation lab by utilizing interactive animations in this module.

3.2. Design of Product
Module is developed in five phases: 1) observing, 2) asking, 3) collecting data, 4) analyzing, and 5) communicating [9], to empower science process skills of students in the form of 1) prediction, 2) planning the experiment, 3) collecting data, 4) making conclusions, and 5) communicating [10],[11],[12] on the subjects of solubility equilibrium concept. The first draft of these modules includes:
3.3. **Introduction**

The introduction of the module contains: 1) The front page, 2) Learning indicators 3) Information module, 4) Instructions for use modules, 5) Contents module, and 6) Concept map.

![Figure 1. The front page and concept map](image)

3.4. **Content**

The contents are scientific-based learning activities to empower science process skills. Those comprise observing, asking, collecting data, analyzing and communicating. Each of these will be elucidated in the following subsection.

3.4.1. **Observing**

This section presents an everyday life phenomenon in accordance with the material to be learned. Students are instructed to observe the phenomenon and do predictions. This activity is expected to bring science process skills.

![Figure 2. Phenomena and Prediction Activities](image)

3.4.2. **Asking**

This section presents an appeal to encourage students to actively ask when experiencing difficulties. It expects that students can be active learning activities.
3.4.3. Collecting Data
Collecting data section shows about problems. Students are encouraged to solve the problems through virtual lab activities which is interactive animation based. After that, the students record the results. Expected in this activity students can empower planning experiment skills and skills in collecting data.

3.4.4. Analyzing
This section is given the discussions and exercises. Students analyze the results of experiments and connect those to the existing theory (theory concepts presented in the form of text, images, animation, and video). It is expected that students can empower skills in make conclusion through this activity.

3.4.5. Communicating
In this section, students are encouraged to present their experiment in front of the class. Students are expected to empower the skills to communicate something.
3.4.6. Closing
The closing section contains final exam and references.

3.5. Validity and Feasibility of Product
It is use of Aiken formula for validating the module [13]. To make it effective, the study employs seven validators and 4 validity criteria ranging from irrelevant to relevant. Therefore, according to Aiken table, it is valid if the value of \( V > 0.76 \). Aiken result of the calculation formula is shown in Table 1.

```
| No. | Aspects    | Average Value V | Description |
|-----|------------|-----------------|-------------|
| 1   | Content    | 0.89            | Valid       |
| 2   | Linguistic | 0.87            | Valid       |
| 3   | Serving    | 0.93            | Valid       |
| 4   | Graphic    | 0.90            | Valid       |
|     | Average    | 0.89            | Valid       |
```

Based on the table above, this android module fits for use. It is characterized by a score above 0.76 \( V \) which means every aspect is high enough. Product testing of this scientific-based chemical android had done 3 times in 3 schools with a different number of respondents in each step. The first stage was a preliminary field test and revision, this step was done by providing scientifically-based android modules to 10 students (5 students randomly in SMA N 1 Teras and SMA N 3 Boyolali). After the students were given a questionnaire to respond to the module in terms of legibility modules. The questionnaire results in the test phase are to get the numbers 70.42%, this indicates that the module is feasible for the next test.

The next product testing was the main field test and revision. At this stage, android modules have been improved based on the results of the revision of the preliminary field test. Respondents used were 32 students (16 students each SMA N 1 Teras and SMA N 3 Boyolali). Students were given the module android then use it and evaluate it. After the students were given a questionnaire to assess the response of the module. The resulting assessment of students in this major field test to get figure 75.21%, this increase in the previous test (feasible for the next test).

The next step was operational field test and revision. At this stage, Android modules had been improved by the results of the revision on the next major field tests backtested to different respondents. Respondents used were 90 students and 3 teachers of subjects (every 30 students and one teacher at SMA N 1 Teras, SMA N 3 Boyolali, and SMA N 1 Kemusu). Students were given the module android then use it and evaluate it. After that students and teachers were given a questionnaire to assess the response of the module. The questionnaire results at this stage operational field trials are presented in Table 2.
Table 2. Results of Operations Field Test (Students)

| Indicator Assessment | Value (%) |
|----------------------|-----------|
| Content              | 83.13     |
| Linguistic           | 80.14     |
| Serving              | 79.31     |
| Graphic              | 84.72     |
| Average              | 81.63 (Very Good) |

Based on the above table it can be seen that the assessment of students got 81.63%, it showed that this module is very good and very feasible to use. Advice and input from students can be seen in Table 3.

Table 3. Suggestions Students of the Module on Operational Field Test

| Recommendations | Revised |
|----------------|---------|
| The module should be made not only for one concept. | Might be considered in the next study. |
| Less include discussion questions, so some models matter cannot be done and a lot less because the example | has been awarded a discussion of and increase the number of exercises appropriate advice. |

Table 4. Results of Operations Field Test (Teacher)

| Indicator Assessment | Value (%) |
|----------------------|-----------|
| Content              | 68.75     |
| Linguistic           | 77.09     |
| Serving              | 77.08     |
| Graphic              | 72.22     |
| Average              | 73.89 (Good) |

Based on the above table it can be seen that teacher assessment in the operational field testing is gaining 73.89% and characterization as good. Suggestions for teachers to the module at the operational field tests are presented in Table 5.

Table 5. Suggestions Teacher of the Module Operational Field Test

| Advice | Revised |
|--------|---------|
| The module is ready to use. | This module will be implemented. |

3.6. Discussion

Based on the result of validity and feasibility product, we can be concluded that Android module feasible for chemistry learning. The result of validity and feasibility product can be seen in Table 6.

Table 6. Result of Validity and Feasibility Product

| Module Test         | Value | Description |
|---------------------|-------|-------------|
| Validity            | 0.89  | Valid       |
| Feasibility (Student)| 81.63 % | Very Good |
| Feasibility (Teacher)| 73.89 % | Good       |

Scientific-based Android Module good for chemistry learning because it has a virtual laboratory. It can help teacher and student to learn about experiment before they do it for real. With scientific approach in this module, science process skills can be empowering. This is match with several studies. For
instance, research conducted by Supriyatman and Sukarno [14] on the improvement of science process skills using inquiry learning using computer simulations concluded that the application of interactive computer simulation in inquiry learning becomes a recommendation for teachers to improve the ability of the process of science in learning primary and secondary. It supports this research because the modules to be applied are adapted to a scientific approach that contains computer simulations. So it can improve the science process skills.

Research conducted by Osman and Vebrianto [15] on the use of multiple media to improve learning outcomes and the ability of students' science processes on Biology learning can significantly improve student performance in learning and improve the ability of the science process. Pekdağ [16] discussed that alternative methods to chemistry learning can have a variety of learning aid such as animation, simulation, video and other multimedia. To conclude, teachers should be smart in the development of technology in this latest era. One of them utilizes ICT technology. Chemical learning that utilizes animation, simulation, video, and multimedia (ICT) effectively becomes an alternative method that is well applied in learning. That two studies can be supportive that the module to be applied is electronic (utilizing ICT technology) and also has multiple media that is text, audio, video, and interactive animation. Therefore, this module can meet the requirements in improving students’ science process skill.

Fathonah [17] studied the development of inquiry-based chemistry multimedia simulative for qualitative analysis materials. The development of this multimedia is suitable to be explained by computer-assisted media or simulation. The selection of media according to the content of the lesson in which the computer or simulation provides a high percentage of media compatibility with the content of the lesson that is factual, contains many concepts and procedural. The result of this multimedia is perfect for improving cognitive and social attitude students. In addition to focusing on improving the science process skills, research needs to consider improving student learning outcomes. The modules are adapted bring the solubility equilibrium contents so as to require the help of computer simulations in explaining the theory. This development android module was in accordance with the research of Fathonah [17].

Pinilih [18] developed a physics-based electronic module of mutual-material global warming for SMA / MA class XI. Physical electronic module based on mutuality of global warming material is a module containing video, animation, and simulation with learning step refers to the approach of mutuality, namely challenge, initial answer, revision, source, and group work. The development of this module proves the features for improving student learning outcomes. Based on this, by applying various interactive media in it will improve student learning outcomes. this module is also tailored to the method of learning that lures students to not only learn the concepts and principles of science verbalized.

The study conducted by Lestari [19] discusses the development of integrated multimedia IPA module with a scientific approach to the theme of waste for class VII SMP / MTs. Integrated IPA learning with the integrated model is more efficient in time because the material that has been studied does not need to be studied again in the next learning. The result of this research shows that developed module has good quality so that it can be used in science learning. An integrated IPA module with a scientific approach to the waste theme has been used in highly effective learning. Research conducted by the researchers also apply scientific learning in the module developed by video, animation, text and other media. Based on the Lestari research, it is expected that this module can be effectively applied to learning chemistry material.

This module is based on scientific approach. Based on the feasibility and validation test, this module can be used to empower the science process skills. This is in accordance with some research that is. Burak Feyzioglu [20] in his research discusses the investigation of the relationship between science process skills in the use of laboratory and the achievement of science in chemistry learning. This study concluded that learning using experiment activities in the laboratory can significantly improve the ability of students’ science processes. The problem that arises in school learning that has been observed is the lack of time required for teachers to carry out laboratory activities. Teachers have realized that experiment learning is very effective in improving students’ science process skills. So, this study
developed an Android module containing virtual lab labs, so if that experiment activity is disconnected due to lack of time, can be continued through a virtual laboratory that has been developed.

The article compiled by Zeidan and Jayosi [21] discusses the formation of attitude and skills of the scientific process through schools that apply science in their learning. This research is applied to students in Palestine. The conclusion of this study is through science learning can improve skills in terms of observation, prediction, and measuring students. this study proves that the empowerment of science process skills can arise because of the application of the scientific approach. The developed Android module has been scientifically based so it is likely to improve the science process skills according to the research by Zeidan and Jayosi.

Guritno [22] implemented chemistry learning through problem-solving and inquiry models in terms of scientific process skills and students' scientific attitudes. Facts in school, in chemistry learning, exemplified that many students only learn the concepts and principles of science verbally or students learn but do not know the meaning of what they learn clearly. This way of learning causes students, in general, to only know a lot of scientific terms by rote. This is the basis of this research. The result is the effect of active learning (problem-solving) on the increasing skills of the science process.

A study by Amelia and Syahmani [23] on improving the science process skills and student learning outcomes through a scientific approach to redox materials suggests that the effect of applying scientific approaches proves to be effective in improving the skills of scientific processes, since scientific components can elicit the skills of the scientific process when done with correct. In addition, the application of a scientific approach can improve student learning outcomes in chemical materials. This is the basis of research conducted by the researcher is the development of scientific based electronic module. It is expected that this module can guide students to be active in science activities so as to bring up the science process skills.

Based on several studies of electronic modules, it can be concluded that learning to utilize electronic media can be an alternative for students to gain learning quickly and fun. Based on research studies of science process skills, the scientific approach is one way to improve the skills of the science process well. So from several studies that have been described above can be concluded that combining electronic modules based on science is an effective development in improving the skills of the science process.

4. Conclusion

The development of a scientific-based (observing, asking, collecting data, analyzing, and communicating) android module on solubility equilibrium concept for science process skills empower (prediction, planning the experiment, collecting data, making conclusions, and communicating), used Borg and Gall's steps until stage nine (Information collecting, planning, develop a preliminary form of products, preliminary field testing, main product revision, main field testing, operational product revision, operational field testing and final product revision. The result of validation of the module contents got V = 0.89 (Valid), and the results of the feasibility test obtained 81.63% (by the student) and 73.98% (by the teacher) indicates the module gets good criteria. Based on several data, it can be concluded that android module can be an alternative for students to gain learning quickly and empower science process skills.

Acknowledgement

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