Does learning chemistry by representation with “Jaman-Now App_Permilang” effectively impact students’ cognitive & motivation?

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Abstract. Technology has become a major component in every aspect of human life, and learning resources had included in that aspect. This issue described media for learning the “Jaman-Now App Permilang (JNAP)” can have an effect on students’ cognitive and their motivation in the learning process. The quantitative approach was the method used in this study, where this research was a part of the development research conducted by researchers, in which this research presentation specifically explained aspects of the effectiveness of the product being developed. Product feasibility tests are carried out in the school environment through two processes (limited & extensive test). Those processes were used with observation, testing, and questionnaire techniques as a measure of product success. The feasibility of this research focused on the effectiveness of the product in chemical learning where this effectiveness is assessed as an indicator of product feasibility with a valid instrument (cognitive tests, questionnaire). Statistical data revealed that the average N-Gain in the 1st process has a point of 0.25 (low), the 2nd process was 0.42 (medium), and very good criteria for the motivation aspect. The results indicated that the product has a good enough impact on the co-positivity and motivation of students, although the visualization of the values shown in the medium criteria. In other words, the product has the potential to become one of the strategies in improving the quality of chemical learning, assessment for chemistry learning, strengthening their cognitive, and guidelines for students in reflecting themselves in an understanding of the chemical material.

1. Introduction

Learning based on application is one of the strategies and renewals of learning that is able to accommodate students who have difficulty in learning, especially in learning science such as chemistry. According to [1] Chemical content involves the concept of representation where participants optimize their imaginative abilities so that they can interpret chemical material. The best solution for the students to be able to understand chemical material based on its contents is by mastering the basic concepts of chemistry and having the ability to analyze content in a representation manner (macroscopic, sub-microscopic, symbolic) [2,3]. Chemistry Learning by integrating the concept of representation will make the students easier in understanding the chemical materials, especially learning chemistry at the particulate level [4–9]. It means that the cognitive development of the students will experience a lot of progress when they learn in representation way so that misconceptions can be reduced [10].

Development of instructional media based on application becomes a challenge for teachers to create exciting learning activities that make learning to be more memorable, like what being described
by [11] that, teachers must be able to make a renewal and innovation in the learning process with the aim of stimulating the mindset, the ability of reason, the critical thinking ability, and the spatial ability of the learners so that their cognitive is much more developed and more mature in learning [12–15]. This strategy is also considered capable of increasing their motivation in learning so that the students will be interested to learn, to understand scientifically, and to strengthen their preconceptions. It is reinforced by [16] who described that the learning media is used by teachers to transmit knowledge to learners, with the use of learning media the students are able to receive information more effective because it is not only based on modern technology, but the media aspect is also able to deliver messages visually. Reference [17] explained that through technological advancements, the teachers could use a variety of media in accordance with the needs and learning objectives, and [18] that technology can help teachers deliver the subject matter to be more varied and innovative when compared to conventional methods.

Learners’ motivation is triggered by how far technological contribution teach them because the students need a new experience [19,20] that is capable of opening their thought about the unique learning way based on information communication technology (ICT) [21]. ICT gives the students opportunity to improve their conceptual understanding, to form high-quality mental models and to strengthen their preconceptions into scientific concepts [9,22,23]. The motivation of the students is related to the results of cognitive learning, each individual has different level of ability and background of experience [24], so it needs stimulation such as the media to grow their reasoning in learning chemistry. The students' learning progress is able to be seen from their cognitive structure and their ability to analyze chemical contents; it means that learning chemistry through media is not just looking at the media but how they are digesting information and interpreting the message contained in the material [25].

Chemistry Learning by using Jaman-Now App based on PERMILANG (Crosswords Chemistry Games) on the material structure of atoms and periodicity properties of elements can be expected to reduce misconceptions on the learners. In addition, learning through this application is able to analysis the cognitive tendencies and motivation of the students in learning chemistry. Chemical contents and features presented in this application have the potential and contribution to improving the quality of teaching and learning chemistry, so it is able to increase the learners’ cognitive learning outcomes and motivation. Considering the rapid development of technology year by year until nowadays, the learning based on this application has the potential to erase the mindset of the students regarding that Chemistry Learning is considered difficult by the students and the broad community. In other words, this research focuses whether learning based on this application gives impacts on the cognitive and motivation of the students to learn chemistry in order to have a proper scientific perspective. Reference [26] explain that Computer-based chemistry learning affects students’ cognitive. Even like that, JNAP products have differences; namely, the presentation of material in learning adopts the concept of representation with the application of JNAP. Other offerings are various features in the chemistry learning process, such as there are chemistry questions for analyzing misconceptions, content-based content representation, and learning through game concepts such as quizzes, problem analysis, and case identification. Application with supporting educational features can train students to think critically, creatively and metacognitively so that misconceptions can be reduced slowly. That is, the research [26] and the research conducted have a positive influence, but the aspects of the presentation and the concept of learning are different, in other words, this research concept is a form of renewal in understanding chemical materials in representation perspective, and other things explained earlier.

2. Method
The research method used was experimental research (pre-experimental/the one-shot case study case study) [27]. This research was a part of the development research conducted by researchers, in which this research presentation specifically explained aspects of the effectiveness of the product being developed. The sample distribution was divided into two, which are limited trial and extensive trial.
The sampling technique used was purposive sampling. The sampling locations were carried out at Banjarmasin Senior High School. The data collection technique used was questionnaire technique and test, where the research instruments used were cognitive test instrument and motivation questionnaire. The data analysis technique used was descriptive statistics by knowing the average score of the students through test of cognitive learning outcomes. Cognitive learning test results were divided into two stages, which were pre-test and post-test, and was stated by normalized gain score of N-gain [28], while the motivation questionnaire shortly was given after the learning process was carried out.

3. Result

3.1. The Description of Jaman-Now App

The Jaman-Now App is a chemistry application that adopts the concept of representation to train students’ particulate level abilities so that they do not experience misconceptions in learning. Also, this application contains general chemical material (atomic structure material), and then contains a crossword puzzle based features that are the advantages of this application. Although, this application is a new concept, the features that are brought are a form of integrating technology such as a chat feature to facilitate student communication if there are problems in learning. Social media features like Instagram also complement this application. Other content is also chemistry questions that can enhance students’ critical thinking abilities and materials with the concept of representation, adding value to the developed application.

3.2. Product feasibility test (effectiveness)

Learning chemistry by using Jaman-Now App based on PERMILANG (Crosswords Chemistry Games) or called JNAP was implemented in Banjarmasin Senior High School. This graph shows the...
measurement accumulation through the Normality- gain (N- gain) test to find out the improvement or progress of the students’ learning outcomes by using JNAP on the material of the atomic structure and the periodicity properties of elements. The students on the limited pre-test trial got an average of 46.83, and after the post-test, there was an increase in learning outcomes, which became 60.58.

Figure 3 above shows that the testing that had been done provides information on the pre-test and post-test learning outcomes in a limited trial and extensive test. The limited trial is the basis that becomes reference whether the media gives impacts on the learning or not. After limited test, the researcher also conducted extensive trial test. This extensive trial aims to strengthen that this application has a role and contribution in improving the students' cognitive learning outcomes.

The extensive trial shows an average of 35.92 in pre-test learning outcomes and 62.98 in post-test learning outcomes. When compared with the results of the study in limited tests, the result is increased steeply, so it shows that during Chemistry Learning process by using JNAP, it gave the students different learning experiences. The improvement in the statistical value above is also a picture of their cognitive learning progress. It means that the media contributed appropriately in learning process of chemistry.

The statistical data above also shows that the learners were able to learn chemical material about atomic structure and elements periodicity properties in representation manner (sub-microscopic, symbolic) effectively. Effectiveness based on statistical data is interpreted that students experience a change in learning chemistry using JNAP, where their perspective turns into more scientific concepts. This is, students realize that learning with the chemical representation concept has given them knowledge of how to understand chemical matter in-depth, moreover atomic structure material is the most basic material for learning chemistry. Another reason is the question exercise feature integrated into the media also triggered the students' critical thinking patterns so that their progress is seen to develop. It means that JNAP is effective in packaging the material of atomic structure and the elements periodicity properties so that with the questions in the exercises on JNAP, it can improve their thinking and analytical skills. This "Jaman-Now App" does not only include chemical content, but there are also PERMILANG games (Crosswords Chemistry Game) as well as interesting, interactive, communicative features that gives unique impression on the learning.

| No | Learning outcomes | Category | Limited Trial | Extensive Trial |
|----|-------------------|----------|---------------|-----------------|
|    |                   |          | Pre-test      | Post-test       | Pre-test       | Post-test       |
| 1. | 93-100            | Very good| 0             | 2               | 0              | 2               |
| 2. | 84-92             | Good     | 0             | 1               | 0              | 1               |
| 3. | 75-83             | Enough   | 0             | 1               | 0              | 1               |
| 4. | <75               | Less     | 33            | 29              | 33             | 29              |
Table 1 above is limited trial data for data reinforcement. 33 students received scores less than 75 in the pre-test, and in the post-test, there were 2 students who got scores in the range of (93-100) in the very good category. In other words, to conduct further trials, (extensive trial) is an appropriate step to find out the extent of JNAP's contribution in improving the students' cognitive.

Figure 1, on the right side, is the average of N-gain score in the limited test class and extensive test class. This graph is related to the one on the left (average score of cognitive test results) because it shows the role of JNAP in improving the learning outcomes of Chemistry Learning in the material of Atomic Structure and Periodicity Properties of the Elements. It can be seen that the N-gain in the limited test is 0.25 in the "low" category, then the N-gain in the extensive test is 0.42 in the "medium" category. The difference in that N-gain score shows that there was increased steeply. Although this increase was not up to the high category, it has shown that there was a contribution of Jaman-Now based on PERMILANG in progress of learning chemistry.

Table 1 above also shows the comparison of pre-test and post-test scores carried out in an extensive trial in XI MIPA 1 class of SMAN 1 Martapura. The data that had been obtained shows there was a reinforcement on the achievement of JNAP based on PERMILANG by seeing the change of the scores they have acquired. Based on these cognitive learning outcomes, it is important to conduct limited trial before conducting extensive trial; it is because when the limited trial has been done then we can find out what are the deficiencies in our product so that extensive trial achieves better results from limited trial.

In the post-test score of extensive trial, there were students who got score in the range of 93-100, namely the student who has a score of 93.24, respectively. The cognitive learning outcomes obtained by those students are almost close to perfect scores. While students who got score <75 in the post-test shows a change if in the pre-test there were 33 students who scored <75, but in the post-test the students who scored <75 were reduced to be 29 students. Of course, this is a good chance for the category of new product implementation, and although this is not a quite large achievement, it becomes a reference for teachers that learning chemistry by using this application is able to change the mindset of the students in interpreting the material of Atomic Structure and Periodicity Properties of Elements. If the students continue to practice learning chemistry using this Jaman-Now App based on PERMILANG (JNAP) then their mindset will certainly continue to increase so that negative perceptions about chemical material are gradually eliminated with this application as one way to accommodate the issue. In line with [29] the science-based learning and technology (classroom redox reaction) implemented in the classroom was able to show significant progress compared to the classroom that did not implement the aforementioned learning concept, where students achieved average learners' cognitive scores in the experimental class were 7.8 whereas in the control class were 7.4.

Strengthened by research from [30] that, with android-based chemistry learning media, students have experienced cognitive changes where the average cognitive achievement in the experimental class was 80.31, while in the control class was 77.81, and also increased student motivation. Besides, learning chemistry with the concept of representation becomes part of renewal in understanding chemistry so that students are not handicapped in interpreting chemistry. Technology collaboration and representation concepts are part of the chemistry learning innovation that can be a breakthrough in improving the quality of students' abilities and teaching chemistry [1,3,8,31,32].

3.3. Students’ motivation questionnaire
The importance of learning motivation in learning chemistry is very needed, and it is because motivation can arouse the students' enthusiasm for learning, and this is one of the things that is difficult for teachers to foster the students’ enthusiasm. Reference [21] argued that the contribution of technology is one way to trigger the growth of their learning motivation. Reference [33] adding that education technology is a learning approach that needs to be applied to make the learning process
more effective and that they have the competency to face the 21st-century era. It means that motivation is one of the important things that must be considered by the teachers especially in teaching and learning of chemistry that starts from the previous perception.

![Figure 4. Percentage of The Students’ Motivation in Chemistry Learning Using the Jaman-Now App based on PERMILANG](image)

Percentage data of Figure 4 shows that the motivation of the students in the limited test reached 57.43% in the “weak” category while in the Extensive trial, the percentage was 73.77% in the “strong” category. Thus, the JNAP media (Jaman-Now App based on PERMILANG) affected the psychology of the students which their learning motivation was increased. Research by [34] revealed that learning process that using games based media can give motivation and strengthening students’ understanding of learning (strength in theoretical and practical aspects). In addition, JNAP has the potential to have a positive impact on the students because if the motivation to learn chemistry has grown in the soul of the students, the creativity and critical elements in learning chemistry will grow gradually. The strengthening is shown from the N-gain score that the students have experienced progress in cognitive learning. The implementation of the JNAP application is effective in learning chemistry even though it is relatively new. The students also just used this JNAP application for the first time, but they have experienced good cognitive progress so that learning chemistry with JNAP can be said to be effectively used. Other aspects that support the JNAP application are games, chatting, Instagram, and Facebook, which of course it gives a special attraction for the students to learn chemistry. Therefore, this learning application has great potential in influencing the students’ cognitive development and motivation.

As explained earlier that according to [30] that, learning chemistry based on android technology can affect students' cognitive performance as indicated by the cognitive achievement of 80.31 in the experimental class, whereas in the control class by 77.81, and also increases their motivation in learning, that is, the use of technology-based learning media has an extraordinary impact on students in learning chemistry. Motivation is the most important component in stimulating students in learning [9,35,36], especially chemistry, in which chemistry is a material that requires high reasoning power. In other words, learning chemistry with instructional media has a good effect on students [11,37–40].

4. Conclusion
Jaman-Now APP Application based on PERMILANG is a Chemistry Learning media that can be used as one of the strategies in increasing the students’ cognitive and motivation. this is confirmed by statistical data revealing that the average N-Gain in the “limited test” process has a point of 0.25 (low), “extensive test” is 0.42 (medium). Other data show that students’ motivation in tests is limited to 57.43% in the “weak” category while in extensive trials, the percentage is 73.77% in the “strong” category. Moreover, this application can be a guide of studying chemistry independently, and this application can also be used as a learning resource where the students are able to deepen their understanding of chemical materials. Learning in representation through this application is also an important point to prevent misconceptions and weak understanding of the students’ concepts in a scientific manner. This implementation can be said as practical work, but digitally, it means that how
the students maximize their cognitive abilities in analyzing material in representation so that motivation and interest continue growing within themselves.

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