

The Effect of Smartphone on Students' Critical Thinking Skill in Relation to the Concept of Biodiversity

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Abstract The advance in technology and communication currently has significantly influenced the development in the field of education, including the use of smartphones that can be adopted as a source of learning in schools. The current study was conducted to investigate the effect of smartphones on students' critical thinking skill in relation to the concept of biodiversity. The population of the study was all year-11 students of Senior High School 5 Samarinda, while the sample was the science-program class XI 2 (learning with Smartphone) and XI 3 (learning without smartphones) with 25 students for each class. The obtained data were analyzed with t test and the obtained value of $t_{\text{calculation}} = 4.30$ and $t_{\text{tabulation}} = 2.01$. The result of the data analysis showed that the value of $t_{\text{calculation}} > t_{\text{tabulation}}$ at the significance level 0.05, so it is concluded that learning with smartphones has the effect on students' critical thinking skill in relation to the concept of biodiversity.

Keywords: *smartphone, critical thinking skill*

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1. Background of Study

Education currently is a must that is not only accessed from educational institutions such as schools, private institutions or something like that, yet education is any effort, influence, protection, and assistance provided to children for their maturation, or for helping children to quite capably carry out their own life tasks. The influence can be derived from older partners or from something created by adults such as schools, books, the daily life activities, and many others, which is addressed to people who have not grown. Hence, education is not only obtained from adults such as teachers, but is created by adults through books and etc. that can support the development of children (Hasbullah, 2006).

Education is a process in the case of influencing children so that they can adapt with their environment at best, and triggering changes in them, as well as helping them to take role significantly in society. This means that education teaches children to take role as an individual and as a part of their environment.

Education today develops simultaneously with the development of science and cannot be separated from the development of technology and communication. There are various numbers of technology and communication devices that can facilitate educators in their instruction, either as a teaching aid or medium used in the learning process. The teaching aid that is often used currently is the OHP (Over Head Projector). If viewed from the progress of technology, education can be developed in different

ways, including learning by using electronic media such as television, internet, to the use of cellphone (handphone).

As the rapid development of the times and technology, electronic gadgets emerges, for instance, mobile phones or handphone that not only has the function as the sender of a text message but also as a device for the long-distance conversation. Mobile phones now have varied functions, ranging from the emergence of music player application, camera, up to the application that makes it easy to surf in the cyberspace or internet. The cellphone with a complete function is called smartphone (derived from 'smart phone'). The Smartphone or this smart gadget can be named as a mini computer because it has the function like a computer in its mini version and is portable.

According to Sarwar and Soomro (2013), smartphones have been existing since 6 years ago when one of the largest communication and technology company, Apple introduced the smartphone to the free market, yet in fact smartphones have already been produced on the market since 1993. The difference between the current smartphone and the previous one is that the earlier version was more prominently used as equipment in a company, and the price was considered too expensive for the public users. Because of slow technological developments in the past, and the unaffordable price, the users of mobile phone were limited to some people and certain groups only.

Basically cellphones were created for adults who have effort to simplify his job. But over time, they begin to enter among teenagers. Although the smartphone in fact has many functions, but for teenagers, it is used more for chatting with friends, looking for new friends through

social media, or exchanging images or photographs, which has nothing to do with the duty of a teenager to learn.

Based on the study conducted by Barakati (2011), smartphones were used not only as a communication tool, or just to keep up with technology, but it could be used to learn and improve students' skills in English language learning if it were used properly. For teachers, Dijey suggested that they motivate students in maximizing the use of smartphones in English language learning and apply the use of smartphones by utilizing existing applications to the classroom, so as to improve students' ability to learn English in a more innovative and fun way. The study was focused on learning the English language, but the same method can also be done on another area like learning biology. This is supported by the fact that smartphone offers various websites, social account and social network, or internet that can be used to assist students in comprehending the concept of biology, as well as to enhance their eagerness for learning, and to increase their knowledge in a more relaxed and enjoyable way.

Woodcock (2012) claimed that with the increasing number of students who have smartphones, various aspects of their lives change, they begin to operate this gadget for expanding their learning experience. The use of smartphones in learning can lead students to become more aware of the advantages and benefits, such as the ease of learning anywhere and anytime, as well as can motivate students in learning activities. This explains how potential of a technology in opening and expanding students' horizon, especially on the students themselves academically.

Sarwar and Soomro (2013) argued that the negative impact of using smartphones in learning still existed, for instance, sending messages to exchange answers with other students, reading answers recorded in the smartphone as a way of cheating in the classroom, even it might have a negative impact on the health of the users. However Rusman (2011) added that the advantage of the internet in learning is the possibility of education circulation to all parts of the country and the unlimited capacity since it does not require a classroom; the teacher can select topics or instructional materials in accordance with the wishes and needs; being accurate and being up to date learning materials; and learning can be done interactively, so it attracts students and allow interested parties (parents or teachers) to contribute to the success of the learning process by checking tasks performed by students in online.

Many ways can be done to put the smartphone functions into a more positive direction, especially for the students. Students' intention to do less important thing often becomes the main problem. If this is not properly anticipated and abandoned, then this will obviously influence their ability to think, consequently can influence the results of their study.

The result of interviews conducted in November 2013 in the Senior High School 5 Samarinda showed that most students and teachers in the school used smartphones. They were not only used as a means of oral and written communication, but were also used for browsing the internet to find data or information related to the learning activities while simultaneously for accessing online social networking related with the necessary knowledge. Through the internet browsing students and teachers can

be assisted in the learning activities in the classroom. The use of smartphones in the learning process in this way is very rarely done, though in fact the smartphone has become a device owned by a lot of students, so it is necessary to make use of this gadget in the classroom. It is interesting for the researcher to conduct a study in the use of smartphones in learning biology in relation to the concept biodiversity in Senior High School Samarinda 5 in order to investigate the effect of using smartphones on students' critical thinking skill. The research problem in the current study was formulated as "how is the effect of smartphones on students' critical thinking skill in relation to the concept of biodiversity?" The purpose of this study was to investigate the effect of smartphones on the students' critical thinking skill in relation to the concept of biodiversity.

2. Method of Research

The current study adopted the quasi-experimental research method to investigate the effect of the independent variable (smartphones) on the dependent variable (students' critical thinking skill) in relation to the concept of biodiversity.

2.1. Time and Place of Study

The study was conducted in October 2013 until April 2014 in Senior High School 5 Samarinda

2.2. Population and Sampling

The population in this study was the year-11 students of science-program of Senior High School 5 Samarinda in the school year 2013/2014, consisting of 5 parallel classes with 149 students enrolled. The sample was determined based on the specific purpose (purposive sample) by considering the scores of students' report cards that were relatively the same. So, it was determined that the sample consisted of 2 classes, that is, science-program class XI 2 and XI 3 with the total of 50 students who had relatively similar grades and had a smartphone.

2.3. Research Variable

The independent variable in the current study is smartphones, used as a medium of learning for searching for learning materials fitted to the topic. The Indicator of smartphones is the internet browsing as an additional search for materials under the assumption that students with smartphones had the same internet speed. Students were divided into groups consisting of 2 to 3 members who had smartphones used to open any websites predetermined by the teacher, then the materials were discussed by each group.

The dependent variable of the study is students' critical thinking skills acquired through the learning process within certain period assessed by the rubric of critical thinking skills introduced by Ennis (2003). The Indicators for critical thinking skills are pre-test and post-test scores on the concept of biodiversity.

2.4. Data Collecting Techniques

The data in the study were collected through 1) Observation, which is the way in gathering supportive information that was carried out by conducting systematic observation and by recording the phenomena as the observation target (Sudijono, 2011). The observation on this phase was conducted to determine the place or location of study and observation of teaching and learning activities in the classroom. 2) Pre-test, the evaluation carried out at the beginning of the meeting before the process of learning took place in every sampling class. The purpose of this initial test was to evaluate the extent of students' knowledge of the material that had not been taught. 3) Post-test, the evaluation was carried out after the end of the learning activity. Final test was useful as to evaluate the students' critical thinking skill after the learning activities were implemented.

2.5. Data Analysis Technique

Data analysis used to determine the effect of the use of smartphones on year-11 students' critical thinking skill of Senior High School 5 Samarinda year 2013/2014 in relation to the concept of biodiversity was done by implementing t-test formula. While the comparison in this study was the result between the pre-test and post-test in the classroom learning that used smartphones (treatment class) and the class that did not use smartphones (control group). According Sugiyono (2009), the t test can be divided into two classes, that is, t test with homogeneous variance and with heterogeneous variance. Either homogeneity or heterogeneity both variances were tested with F test.

$$F_{calculation} = \frac{S_1^2}{S_2^2} \text{ where } S_1^2 > S_2^2$$

If $F_{calculation} < F_{tabulation}$ then the sample is considered homogeneous.

If $F_{calculation} \geq F_{tabulation}$ then the sample is considered heterogeneous.

If the sample (variances) of both samples is homogeneous, the formula will be:

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{s^2 \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

If the sample (variances) of both samples is heterogeneous, the formula will be

$$t_{calculation} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

For figuring out the standard deviance of combination:

$$S_{combination} = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}}$$

Notes:

- $\overline{X_1}$: the average score of group 1
- $\overline{X_2}$: the average score of group 2
- n_1 : the sample numbers of group 1

- n_2 : the sample numbers of group 1
- S_1 : the standard deviance of group 1
- S_2 : the standard deviance of group 2
- S : the deviance of combination

Based on the comparison of the value of the t-calculation and t-tabulation, it can be concluded as follows:

If t-calculation \geq t-tabulation then Ho is rejected and Ha is accepted, which means that there is the effect of using smartphones on biology learning outcomes.

If t-calculation \leq t-tabulation then Ho is accepted and Ha is rejected, which means that there is no effect of using smartphones on biology learning outcomes.

2.6. Research Design

The current study was designed with the quasi-experimental model of pre-test and post-test on the control group.

Table 1. Research Design

| Groups | Pretest | Treatment | Post-test |
|--------|----------------|-----------|----------------|
| A | Y ₁ | X | Y ₂ |
| B | Y ₁ | - | Y ₂ |

Notes:

1. Group A and B were given the initial test (pre-test).
2. Group A as the treatment class used smartphones in the learning process.
3. Group B as the control class did not use smartphones in the learning process.
4. A and B were given the final test (post-test) to investigate students' critical thinking skill.

3. Results of Study

The data of students' critical thinking skill in science-program class XI 2 and XI 3 were described as follows:

Based on the pre-test and post-test results that had been implemented in the experimental class, for the science-program class XI 2 learning with smartphones, the obtained data showed that the average score of pre-test was 44.48 with the value of data variance 58.84. The average score of post-test was 82.20 with the obtained value of data variance 35.16.

Based on the pre-test and post-test results that had been implemented in the control class, i.e. science-program class XI 3 learning without using smartphones, it was obtained average score of pretest result 41.92. Value of data variance was at 33.49. Meanwhile the average score for post-test results was at 75.40 with the value of the data variance 27.50.

Based on the result of data analysis, it appeared that the average score of post-test was higher compared with the pretest score, so it can be concluded that smartphones used in the teaching and learning process had a positive effect on students' critical thinking skill.

Meanwhile the result of normality test of pre-test data is clearly described in the [Table 2](#) below.

Table 2. Result of Normality Test for Pre-test Data

| One-Sample Kolmogorov-Smirnov Test | | | |
|------------------------------------|----------------|-------|-------|
| | | score | group |
| N | | 50 | 50 |
| Normal Parameters ^{a,b} | Mean | 43.20 | 1.50 |
| | Std. Deviation | 6.848 | .505 |
| Most Extreme Differences | Absolute | .074 | .339 |
| | Positive | .074 | .339 |
| | Negative | -.054 | -.339 |
| Kolmogorov-Smirnov Z | | .520 | 2.396 |
| Asymp. Sig. (2-tailed) | | .950 | .000 |

Sources: Research Finding (2014)

a. Test distribution is Normal.

b. Calculated from data.

Based on the calculation of data normality test using SPSS 20.0 presented in Table 2 above, the data of critical thinking skill before the students were given the treatment (pre-test) yielded significant value of Kolmogorov-Smirnov for the classroom learning with smartphones and for class that did not use smartphones, that is 0.95, where $0.95 > 0.05$, thus it is concluded that the data on the students' critical thinking skill in the pre-test were stated normally distributed, so the data can be processed further in the homogeneity test and in the t test as the final analysis in the study.

Meanwhile the result of post-test data normality test is presented in detail in the Table 3 below.

Table 3. The Result of Post-test Data Normality Test

| One-Sample Kolmogorov-Smirnov Test | | | |
|------------------------------------|----------------|-------|-------|
| | | Score | Group |
| N | | 50 | 50 |
| Normal Parameters ^{a,b} | Mean | 78.80 | 1.50 |
| | Std. Deviation | 6.518 | .505 |
| Most Extreme Differences | Absolute | .100 | .339 |
| | Positive | .100 | .339 |
| | Negative | -.073 | -.339 |
| Kolmogorov-Smirnov Z | | .707 | 2.396 |
| Asymp. Sig. (2-tailed) | | .699 | .000 |

Sources: Research Finding (2014)

a. Test distribution is normal.

b. Calculated from data.

Based on the calculation of the post-test data normality test using SPSS 20.0 in Table 3 above, on the data of students' critical thinking skill after a given treatment (post-test), it was obtained the significant value in the Kolmogorov-Smirnov test for the classroom learning by using smartphones and for the class that did not use smartphones at 0.95, where $0.95 > 0.05$, then it can be concluded that the data of critical thinking skill after post-test were confirmed normally distributed.

Meanwhile to determine whether the data obtained from the population were homogeneous or not, F test was conducted. The Criteria for homogeneity test is that H_0 will be accepted if $F_{\text{calculation}} < F_{\text{tabulation}}$ or H_0 will be rejected if $F_{\text{calculation}} \geq F_{\text{tabulation}}$. Since the H_0 was accepted so it was confirmed that the data in the study came from a homogeneous population. Homogeneity test itself was conducted to the pre-test data (test in the first meeting) and also to the post-test data (test performed at the last meeting in each class).

The homogeneity test of pre-test data processed with F test was presented in the following Table 4.

Table 4. The Result of F Test Before Treatment

| No. | Result | Science-program class XI 2 (Learning by using smartphones) | Science-program class XI 3 (Learning without using smartphones) |
|-----|--------------------------|--|---|
| 1. | Average score (X) | 44.48 | 41.92 |
| 2. | Variance | 58.84 | 33.49 |
| 3. | $F_{\text{calculation}}$ | 1.75 | |
| 4. | $F_{\text{tabulation}}$ | 1.98 | |

Sources: Research Findings (2014)

Since $F_{\text{calculation}} < F_{\text{tabulation}} = 1.75 < 1.98$; the samples are considered homogeneous.

Table 5. The Result of F Test After Treatment

| No. | Result | Science-program class XI 2 (Learning by using smartphones) | Science-program class XI 3 (Learning without using smartphones) |
|-----|--------------------------|--|---|
| 1. | Average score (X) | 82.20 | 75.40 |
| 2. | Variance | 35.16 | 27.50 |
| 3. | $F_{\text{calculation}}$ | 1.27 | |
| 4. | $F_{\text{tabulation}}$ | 1.98 | |

Sources: Research Findings (2014)

Since $F_{\text{calculation}} < F_{\text{tabulation}} = 1.27 < 1.98$; the samples are considered homogeneous

Table 6. The Result of T Test Before Treatment

| No. | Result | Science-program class XI 2 (Learning by using smartphones) | Science-program class XI 3 (Learning without using smartphones) |
|-----|--------------------------|--|---|
| 1. | Average score (X) | 44.48 | 41.92 |
| 2. | Variance | 58.84 | 33.49 |
| 4. | $t_{\text{calculation}}$ | 1.33 | |
| 5. | $t_{\text{tabulation}}$ | 2.01 | |

Source: Research Findings (2014)

Since $t_{\text{calculation}} \leq t_{\text{tabulation}}$, $1.33 \leq 2.01$ at the level of significance 0.05, then H_0 is accepted and H_a is rejected. This means that there is no effect of using smartphones on

the students' critical thinking skill before they were given the treatment.

The analysis result for post-test data with T test is shown on the Table 7 below

Table 7. The Result of T Test After Treatment

| No. | Result | Science-program class XI 2 (Learning by using smartphones) | Science-program class XI 3 (Learning without using smartphones) |
|-----|--------------------------|--|---|
| 1. | Average score (X) | 82.20 | 75.40 |
| 2. | Variance | 35.16 | 27.50 |
| 4. | $t_{\text{calculation}}$ | | 4.30 |
| 5. | $t_{\text{tabulation}}$ | | 2.01 |

Sources: Research Findings (2014)

Since $t_{\text{calculation}} > t_{\text{tabulation}}$, $4.30 > 2.01$ at the level of significance 0.05, then H_0 is rejected and H_a is accepted. This means that there is the effect of using smartphones on the students' critical thinking skills after treatment.

4. Discussion

This study aimed to investigate the effect of smartphones on the critical thinking skill of year-11 students of science program SMAN 5 Samarinda year 2013/2014 on the concept of biodiversity.

Students' critical thinking skill was evaluated from the average score of the pre-test and post-test of each class. The pre-test was carried out at the first meeting prior to the learning activities. After the pretest, the next meetings were used to carry out the learning activities based on the lesson plan which had been compiled either for the treatment or control class. Post-test was carried out after learning activities in each class, that is, in the last meeting, to investigate students' critical thinking skill after learning. The pre-test carried out at the first meeting aimed to figure out students' critical thinking skill before learning activities and the extent of students' understanding of the lesson before the material taught in the classroom. Learning activities at the next meetings were carried out by implementing experiments of using smartphones in the treatment class and without implementing experiments of using smartphones in the control class. At the last meeting, post-test was carried out to figure out the students' critical thinking skill.

This is in line with the explanation from Santum (2013) that clarified that pre-test was carried out to figure out students' initial knowledge of a given lesson. By having clear understanding of students' initial learning, teachers may be able to take action in delivering the lesson later. Post-test was carried out to have clear understanding of students' competences after the learning activities were conducted.

The learning in science-program class XI 2 was started from making a group consisting of 5-6 students that was made heterogeneous of those who used and didn't use smartphones. Since students who were not belonged to the samples also participated in the learning activities, so in each group there were students who used smartphones and also the package of data available to be used in the learning activities. Both teacher and researcher had provided learning websites for each meeting that consisted of different learning materials. This had the purpose of ensuring whether the learning materials were relevant or not. After given the materials briefly, students joined their group and discussed the materials delivered by the teacher,

where each group received different materials. After given the time to discuss, students presented their result of discussion in front of the class. After that, other groups were given chances to ask questions to the group that currently presented their result. Each group then answered the questions coming from other groups. This process was in line with the research findings of Barakati (2011) that claimed the learning with smartphones had collaborative impact of sharing information easily with students in the groups.

Learning activities with smartphones more facilitated students and attracted students to learn, so that their perspective extended rather than they used course books only. Learning activities with smartphones also led students more active in the teaching and learning process since they could autonomously search for materials that were not available in the books, so that they could more understand the topics of learning materials in each meeting. This finding is supported by the finding of Rusman (2011) that confirmed if smartphones assisted students to increase knowledge and facilitated more extended education distribution; yielded accurate and up-to-date lesson materials; and the learning activities can be carried out interactively.

The result of the study showed that the science-program class XI 2 using smartphones had the higher average score of critical thinking compared with science-program class XI 3 that did not use smartphones. It can be explained that students who learned with smartphones in the classroom learning appeared to be more active in the discussion. Each member of a group worked well together in discussing the material given by the teacher, and they were very enthusiastic in the discussion / question and answer session between groups. The questions asked by students were also more meaningful. This happened since learning with smartphones could make students' perspectives more open and at once made students get a lot of knowledge that was not covered and included in the course books. Each group also revealed high competitiveness to show the best result in the discussion.

The difference was clearly visible in the science-program class XI 3 where the learning activities were more monotonous since they only relied on their own textbooks. Although teachers used *STAD* learning model, students still looked less active compared with students who learned with smartphones. This was presumably since only a few students seemed to be active in each group, thus this influenced the results of the discussion presented. The questions asked during the question and answer session were only based on the materials given in the book, so students' perspective was not extended compared with their learning by using smartphones. Based

on this finding it was clear that the use of smartphones had positive effect on students' learning activities. These findings were in line with the arguments of Sarwar and Soomro (2013) which stated that students could find all information they need with smartphones, especially through browsing the internet. Browsing the Internet with smartphones made students more easily get the information so that they had better thinking skills and simultaneously could improve their learning outcomes.

Based on the result of the study it was revealed that there was the effect of using smartphones on students' critical thinking skill. This could be seen from the average score of the post-test in both classes comprising of treatment and control classes. The average score of science-program class XI 2, the treatment class, which learned with smartphones before given the treatment was 44.48 while the average score of science-program class XI 3, the control class, was 41.92. After given the treatment the average score of science-program class XI 2 increased up to 82.20 while the average score of science-program class XI, the control class that did not use smartphones, was 75.40. The comparison between pre-test and post-test clarified that the effect was not seen much significant after the given treatment of learning activities were carried out although the post-test score on the treatment class was found higher than the score of the post-test score in the control class. These findings were supported by the arguments of Rusman (2011) which stated that learning with smartphones can be held interactively, so the learning attracts students and allows interested parties (parents and teachers) to contribute to the success of the learning process.

Viewed from the analysis result of research data, it was obtained that the value of $t_{\text{calculation}}$ 4.30 and $t_{\text{tabulation}}$ 2.0 at the level of significance 0.05. Based on these calculation, $t_{\text{calculation}}$ was higher than the $t_{\text{tabulation}}$ ($4.30 > 2.01$). Thus H_0 was rejected while H_a was accepted therefore it was concluded that there lied the effect of using smartphones on the students' critical thinking skill of science-program class XI of Senior High School 5 Samarinda year 2013/2014. This finding was in line with the argument given by Sugiyono (2009), i.e. when $t_{\text{calculation}}$ is higher than the $t_{\text{tabulation}}$ then there is the effect of the given treatment on the desired results.

Viewed from the test results of the data analysis in Appendix 6, it was found that the science-program class XI 2 that used smartphones in learning obtained higher score compared with science-program class XI 3 that did not use smartphones. This proves that learning with smartphones has effect on students' learning outcomes. This occurred since learning with smartphones had advantages, that is, it could make students more interested in the learning activities and students could easily capture the lesson in the classroom since they were given the responsibility to search for more learning materials through their smartphones so that learning activities became more relaxed and enjoyable. Students also had extensive knowledge so that the learning outcomes were better compared with students who only used course books. This relates to the study result of Barakati (2011) where smartphones was used to learn anywhere, to share information and to motivate students to learn, as well as the findings of Smarabawa (2013) where learning with science-based models, especially by using smartphones,

had positive effect on students' learning outcomes because the use of the gadget could increase the students' creative thinking ability in relation to the comprehension in the biology lesson.

The general limitation faced during the process of this study was the lack of WiFi network at the school that did not reach up to the sampling classroom, so students used internet data package for each of their smartphones. The inaccessibility of the WiFi network became an obstacle when in a group that had some smartphones, only 1 or 2 students could easily access the Internet while other students did not. However this obstacle was covered by maximizing other students to work on other things in the group. Difficulties in maximizing the time were also became a constraint where too much time spent in the learning, so some groups had not enough time to answer the questions from the other groups and the questions would be answered on the next meeting instead. This constraint occurred at the second meeting, especially, in the initial learning activities so that in the next meeting the time could be maximized by means of rotating the presentation of discussions for each group where the question/answer session was separated from the presentation among the groups. The first group was welcomed to present their discussion in front of the class. After a group delivered the results of the discussion, other groups were welcomed to ask questions and then the questions were recorded. After that, the first group was instructed to back to their seat and so was the next group. After each group had been given questions, then it was the time to answer the questions of other groups, starting from the first group to the last group. This helped the researcher to maximize the time.

The current study also relied on a review of learning outcomes through pre-test and post-test scores, thus the study can be redeveloped with the addition of questionnaire data to measure the extent of students' comprehension and the extent to which the use of smartphones can affect students' learning outcomes, so that the effect of learning activities can be seen clearly and be more useful.

5. Conclusion and Recommendation

5.1. Conclusion

Based on the result of the study, it can be concluded that there is the effect of smartphone on the biology learning outcomes of science-program students in class XI, Senior High School 5 Samarinda year 2013/2014, as shown from the result where $t_{\text{calculation}}$ is higher than $t_{\text{tabulation}}$ ($4.30 > 2.01$).

5.2. Recommendation

Based on the study that has been conducted, the researcher delivers some suggestions as follows:

1. The use of smartphones is expected to be viewed from the positive side, that is, it can help students increase their knowledge and perspective so that it can be adopted in the learning of other materials or even other subjects by keeping to maintain students in the positive tract.

2. Teachers can maximize the use of smartphones for learning in the classroom and students will be able to use their smartphones to support their learning. Smartphones have many advantages, yet there are also negative sides of using this gadget.
3. The websites that will be used in the learning must also be considered to mitigate the possibility of irrelevant materials with the learning materials. Websites from personal blog should be avoided since the validity of the materials is still in questions than those from the official websites of education or research journal.
4. Schools should more facilitate the internet network (WiFi) so that the signal reaches all classrooms in schools since this is very helpful in the teaching and learning activities either for students either teachers where smartphones offer new materials that maybe not available in the course book.
5. Parents can also monitor their children especially for those that have been trusted to have smartphones, to prioritize their smartphones for learning rather than for other uses that may mitigate their learning outcomes.
6. For the next researchers, it is recommended that they use questionnaire in investigating the extent of the effect of using smartphones on the learning outcomes.

Reference

- [1] Barakati, Dijey Pratiwi. 2011. *Jurnal: Dampak Penggunaan Smartphone dalam Pembelajaran Bahasa Inggris (Persepsi Mahasiswa)*. Manado: Fakultas Sastra Universitas Sam Ratulangi. <http://ejournal.unsrat.ac.id/index.php/jefs/article/download/1820/1431>.
- [2] Hasbullah. 2006. *Dasar-dasar ilmu pendidikan*. Jakarta: PT. RajaGrafindo Persada.
- [3] Rusman. 2011. *Model-model Pembelajaran: Mengembangkan Profesionalisme Guru*. Jakarta: Rajawali Pers.
- [4] Santum, Age. 2013. Pretest – Posttest - Tes Sumatif - Tes Formatif. <http://agesantum.blogspot.com/2013/01/pre-test-post-test-test-sumatif-test.html>. 29 April 2014.
- [5] Sarwar, Muhammad dan Soomro, Tariq Rahim. 2013. *Impact of Smartphone on Society. European Journal of Scientific Research*. Vol. 98 No 2 March, 2013, pp. 216-226.
- [6] Smarabawa. 2013. Pengaruh Model Pembelajaran Sains Teknologi dengan Menggunakan *Smartphone* Terhadap Pemahaman Konsep Biologi Dan Keterampilan Berpikir Kreatif Siswa SMA. e-Journal Program Pascasarjana Universitas Pendidikan Ganesha Program Studi IPA Volume 3 (1), pp. 1-28.
- [7] Sudijono, Anas. 2011. *Pengantar Evaluasi Pendidikan*. Jakarta: Rajawali Pers.
- [8] Sugiyono. 2009. *Metode Penelitian Pendidikan*. Bandung: Alfabeta.
- [9] Woodcock, Ben, dkk. 2012. *Considering the Smartphone Lerner: an investigation into student interest in the use of personal technology to enhance their learning. Student Engagement and Experience Journal*. Volume 1 (1): pp. 1-15.