Android-based learning media on human respiratory system material for high school students

Dwi Maihidin Pahlifi * [1], Mirra Fatharani [2]

[1] Department of Biology Education, Program Pascasarjana, Universitas Negeri Yogyakarta.
Jalan Colombo No. 1, Karangmalang, Yogyakarta 55281, Indonesia.
[2] Monash University. Wellington Rd, Clayton VIC 3800, Australia
* Corresponding Author. E-mail: dwimaihidinpahlepi@gmail.com

Abstract

This research was aimed to produce a product in the form of android-based learning media on the material of the human respiratory system for the Science Class students in XI Grade of High School. This research was performed in SMA Negeri 2 Bantul. The biology learning through the utilization of this android-based learning media has a characteristic which utilizes technology in learning. Therefore, it could be used by anyone, anywhere, and anytime. The method used in this development research was based on the adaptation of ADDIE development model, which consists of five stages, namely analysis, design, development, implementation, and evaluation. The product had been reviewed by the material and media experts. Then, the result of revision was assessed based on materials, operationalisation, and the media display conducted by reviewers (biology teacher) and peer reviewers. Then, it tested on high school students to discover the feasibility of android-based learning media. According to the assessment criteria, the aspect of material, media, and test trial were categorized as "very good". Thus, it showed that android-based learning media on the material of human respiratory system is feasible to be implemented in teaching and learning process.

Keywords: learning media, android-based, respiratory system.

INTRODUCTION

Learning biology subject at school is expected to become the vehicle for students to be capable of learning or understanding themselves and the surrounding environment. Therefore, it can be implemented in daily life. In the ongoing learning activities, students were sometimes unable to understand the explanation of teachers in which they also eager to understand in further regarding what happens within their bodies.

The material of the human respiratory system, the students are having minimum knowledge regarding the processes/mechanisms in every second they breathe. One of them is due to the process within the body, which cannot be observed directly by students. Referring to the Minister of Education and Culture Regulations Number 24 of 2016, the Basic Competences that the students should internalize from the learning process of human respiratory system are analysing the relationship between the organ structure within the respiratory system in relation to the bioprocess and functional disorders that might occur within the human respiratory system and also presenting the results of the analysis toward the influence of air pollution on abnormalities in the structure and the function of human respiratory organ structure based on the literature review (Menteri Pendidikan dan Kebudayaan Republik Indonesia, 2016). During the learning process in biology material, the common activity in the classroom is merely reciting the concept without organising or understanding the concepts that were learned. Therefore, students consider the segments to be utterly unrelated during the learning of human respiratory system material. According to (Kinchin, 2000), biology materials are difficult to be learned because they consist of many unfamiliar concepts which have complex correlations. Schools are frequently teaching

these unfamiliar concepts through the recitation approach. The recitation method might fail in teaching biology, which has complex interaction.

One of the materials considered as difficult by students is human respiratory system material due to the cognitive learning outcome of students that relatively low. The fact in which the material of human respiration system is one of the complex materials is supported by the study of (Tekkaya, Özkan, & Sungur, 2001) which researched the difficulty level of the material by the perception of students. According to that study, the material of human respiration system is the 22nd of 30 levels of materials with the percentages of material difficulty level perception for students were 13.0% and 17.4%.

The development of technology in the education sector has experienced a rapid increase. At present, the education sector is faced against the existence of 4.0 industrial revolution era. The industry 4.0 is the successor of industry 3.0 which indicated by physical cyber and manufacture collaboration (Hermann, Pentek, & Otto, 2016; Yahya, 2018). The feature of the development of Industry 4.0 is the improvement of manufacture digitalization which encouraged by four factors: (1) the improvement of data volume, the strength of computation, and connectivity; (2) the emergence of business analysis, capability, and intelligence; (3) the occurrence of new form of interaction between human and machine; and (4) the improvement on the instruction of digital transfer to physical world (Lee, Lapira, Bagheri, & Kao, 2013).

The excessive use/misuse of the smartphone is one of the impacts of the moral degradation of students due to the rapid development of technology which not balanced with the improvement of character quality of students, although, the development of technology is indeed required by this nation to always compete in the globalisation era. According to (Ali & Purwandi, 2017), the millennial generation in 2017 is them who aged between 17-36 years old; they who now contribute as students, college students, early jobbers, and young parents. The millennial generation is innovators because they seek, learn, and work in the innovational environment which relies heavily on technology to perform transformations in various aspect of their lives (Fatmawati, 2010).

The 2011 study by Boston Consulting Group (BCG) and the University of Berkley showed that the conventional reading manner has decreased because the Y generation prefers to read through their smartphone. Moreover, it revealed that the millennial should have social media as the communication device and the centre of information and they choose phone over television in which anything could be found (Fromm, Lindell, & Decker, 2011).

The utilisation of *android-based* learning media, according to (Calimag, Mugel, Conde, & Aquino, 2014) is one of the efforts to implement the learning style in the 21st century. Also, the utilisation of learning media has a potential to improve the academic performance of students in the form of learning outcome in cognitive scope (T.-Y. Chuang & Chen, 2007; Jabbour, 2014) and learning motivation of students (Calimag et al., 2014; Hess, 2014). Information technology-supported learning media can use to make the learning process as interesting and providing positive impacts toward academic performances in the form of learning motivation and learning outcome of students (Y.-T. Chuang, 2014). While according to (Riyadi & Pardjono, 2014; Sutrisno, 2011), the use of information technology-supported learning media can make the chemistry learning to be more effective.

The implementation of media in the learning process is one of the efforts to create more meaningful and quality learning. The statement is in accordance to the argument by (Mehdipour & Zerehkafi, 2013, p. 94; Pahlifi & Nurcahyo, 2019, p. 6), which imply that the students who operate the media well both inside and outside the classroom are able to understand the learning contents better and are more motivated to operate the learning media when they use the application. Due to that matter, learning media to describe the actual event, which also attracts the attention of students to learn is highly essential. The selection of media is adjusted to the level of child development and concept to be taught to facilitate students in learning the lesson as well as prevent boredom. The purposes of this research and development were to generate a product in the form of *android-based* learning media, discover the characteristics of media that being developed as well as discover the feasibility of media, thus, it can be utilised in the learning process.

METHOD

The data collecting of this research was performed in SMA Negeri 2 Bantul from February to April 2018. The trial subjects in this research consist of material expert namely a lecturer considered as the expert in biology field

and chemistry learning, media expert namely a lecturer as learning media expert, three biology teachers in SMA Negeri 2 Bantul, 13 peer reviewers, 26 students for small group trial and 30 students for the field test.

The product of learning media is validated by material and media experts. The media assessment was performed by the biology teacher and peer reviewers as well. The results of commentary and assessment were used for the improvement of learning media, which then continued by limited trial toward students. The results of commentary and assessment by students were used for the improvement of learning media which continued by field test. After the results of field test have been acquired, then, they used for improvement. Thus, the final product of android-based learning media on human respiratory system was obtained.

This research was using the assessment questionnaire of learning media to collect the research data. The data obtained through trial were classified into two, namely, qualitative and quantitative data. The qualitative data were provided in the form of comments and suggestions by the material experts and the media experts. The material experts who had been invited into the study were a lecturer of Biology from the Faculty of Mathematics and Natural History Universitas Negeri Yogyakarta and a lecturer of Learning Materials and Media Development in Biology from Biology Education Study Program Universitas Negeri Yogyakarta, while the media experts were three teachers of Biology who each taught Grade X, Grade XI and Grade XII. Then, the peer reviewers who had been invited into the study were 13 students from the Graduate Program of Biology Education Study Program Post-Graduate School Universitas Negeri Yogyakarta. Next, the media that had been developed were put into a small-scale experiment in Grade XI IPA 3 Bantul State Senior High School and the number of the subjects in the small-scale experiment were 30 people. The small-scale experiment was conducted to attain revisions on the learning media product. On the contrary, the quantitative data were attained to identify the feasibility of the android-assisted media that had been developed.

The qualitative data that had been attained by means of media quality assessment sheet should be converted into the quantitative data under the following scale: 1 = Very Poor (VP); 2 = Poor (P); 3 = Moderate (M); 4 = Good (G); and 5 Very Good (VG). Then, the quantitative data

were calculated and were categorised based on the quality criteria that might be consulted in Table 1.

Table 1. Media Quality Criteria

No.	Score Range (i)	Quality Category
1.	$X > \bar{X}i + 1,8\ sbi$	Very Good (VG)
2.	$\bar{X}i + 0,6\ sbi < X \le \bar{X}i + 1,8\ sbi$	Good (G)
3.	$\bar{X}i - 0,6\ sbi < X \le \bar{X}i + 0,6\ sbi$	Moderate (M)
4.	$\bar{X}i - 1,8\ sbi < X \le \bar{X}i - 0,6\ sbi$	Poor (P)
5.	$X \le \bar{X}i - 1,8\ sbi$	Very Poor (VP)

(Widoyoko, 2013, p. 238)

Note:
X: Mean Score
$\bar{X}i$: Ideal Mean Score
sbi: Ideal Standard Deviation
sbi = (1/6) (highest score – lowest score)
Xi = (1/2) (highest score + lowest score)

RESULT AND DISCUSSION

Preliminary Study

The initial step in this preliminary study consisted of two activities, namely, literature study and field study. The acquired results from the literature study have discovered that learning through the implementation of learning media could affect the learning motivation of students. This condition is consistent with the relevant research results which provide information that technology has a contribution to the achievement of learning purposes at school. Besides, it has been known that the material of human respiratory system has important role in the body of living creatures and correlating with daily life. Thus, learning media which capable of helping students in understanding the material of human respiratory system more easily. While based on the field study, it has been known that the learning process is still focused on teachers and there is still no utilization of handphone as learning media, even though, almost every teacher and student in SMA Negeri 2 Bantul own smartphone with advanced features.

The Development of Initial Product

The formulation of the media was using Adobe Animate CC 2018 software with action script 3.0. The content and materials of the android-based learning media are divided into 7 menus namely (1) Instruction; (2) Competence (core competence, basic competence, and indicators to be achieved); (3) Material (materials, images, and videos of breathing mechanism, bioprocess of gas exchange between CO_2 and O_2, the danger of cigarette and human respiratory system

disorder); (4) Evaluation (Olympics materials); (5) Glossary; (6) Profile; (7) Introduction (the development background of the media); and (8) Concept map.

The Assessment of Media Product

The assessment of android-based learning media by the media expert was performed by the lecturer of biology learning media. The assessment included audiovisual and software engineering aspects. The media expert provided some recommendations for improvement on android-based learning media that consist of (1) more contrast selection of colour type on texts and buttons which adjusted to the background to be more visible, (2) the size of text should be adjusted, sharpened, and use good selection of font, (3) the order of sub-menu on the main menu should be adjusted, and (4) the selection of background music should be adjusted.

The product assessment of android-based mobile learning media was conducted by the learning material expert, namely biology lecturer. The assessment by material expert included learning and material aspects. The material expert gave attention to the concept of respiratory system material and the questions used in the product. The material expert then gave commentaries as follows: (1) the order of writing or sentences that being used should be easily understood, and the contents of the material are less applicative. Thus, they need to be provided with the example of things associated with daily life; (2) the tricky answers have to be equal. The assessment of android-based learning media by Biology teachers and peer reviewers were performed at different time and place. The product assessment was performed by three biology teachers, namely the teachers of SMA Negeri 2 Bantul and 13 peer reviewers namely students of Post-Graduate Program of Universitas Negeri Yogyakarta in Biology Education Major. Some inputs and recommendations that were provided consist of (1) the materials need to be expanded; (2) the images should be more sharpened and completed.

Analysis of Development Data

The assessment of learning media by media expert, biology teachers, and peer reviewers was reviewed from visual and audio aspects which can be seen in Table 2.

Table 2. Assessment Result Based on Software Engineering and Audio-Visual Aspects

	Number of Items	Average Score	Criteria
Media Expert	22	104,00	very good
Biology Teachers	6	26,67	very good
Peer Reviewers	6	26,23	very good
Total	34	156,90	very good

The total score of the assessment results of learning media by media expert, biology teachers, and peer reviewers for the aspects of software engineering and audio-visual was 156.90 which on the value range of A with Very Good criteria. In that order, the product of android-based learning media was determined as feasible for trials. The percentage of the assessment on learning media based on the aspects of software engineering and audio-visual can be seen in Figure 1.
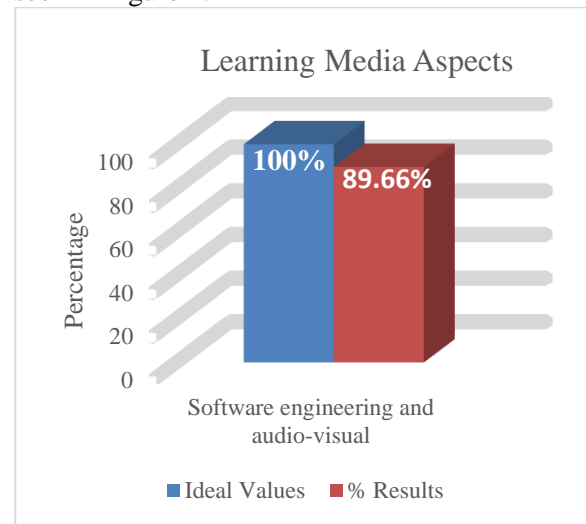

Figure 1. Assessment Diagram Based on Learning Media Aspects

The assessment on learning media by the material expert, biology teachers, and peer reviewers was reviewed from the learning and material aspects which can be seen in Table 2.

Table 3. Assessment Results Based on Material Aspect

	Number of Items	Average Score	Criteria
Media Expert	7	33,00	very good
Biology Teachers	7	33,00	very good
Peer Reviewers	7	32,23	very good
Total	21	98,23	very good

The assessment on Learning Materials by the material expert, biology teachers, and peer reviewers was reviewed from the aspect of software engineering that can be seen in Table 4.

Table 4. Assessment Results Based on Material Aspect

	Number of Items	Average Score	Criteria
Materials Expert	7	30,00	very good
Biology Teachers	8	37,33	very good
Peer Reviewers	8	36,85	very good
Total	23	104,18	very good

The total score of assessment results based on learning materials by the material expert, biology teachers, and peer reviewers for the learning aspect was 98.23, which in the value range of A with Very Good criteria. While for the material aspect was 104.18 which in the value range of A with Very Good criteria. In that order, the product of android-based learning media was determined as "feasible" for trials because it has "good" category from the learning and material aspects. The percentage of learning material assessment can be seen in Figure 2.
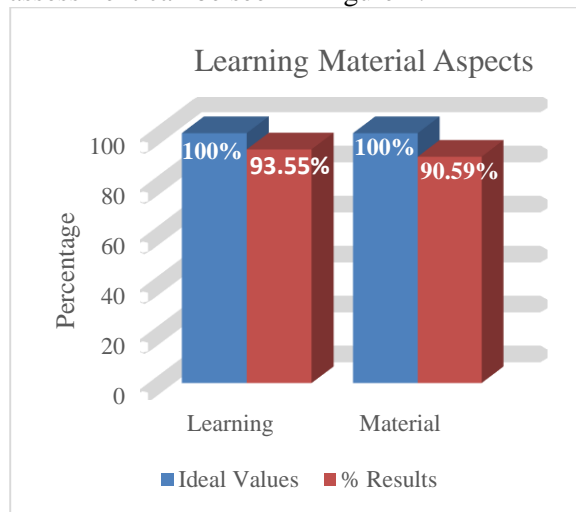

Figure 2. Assessment Figure Based on Learning Material Aspect

The trial assessment consisted of a small group test and field test which reviewed from the learning and material aspects that can be seen in Table 5. Trial assessment for the display and media operational aspects can be seen in Table 6.

The total score of the assessment result based on the learning material aspect conducted by students was 25.53, which in the value range of A with Very Good criteria. While for the assessment result of display and media operational aspects conducted by students was 91.46 which in the value range of A with Very Good

criteria. Thus, the product of android-based learning media was determined as feasible to be used because it categorised as Very Good according to trial results. The percentage of assessment of student trial can be seen in Figure 3.

Table 5. Assessment Results Based on Learning and Material Aspects

	Number of Items	Average Score	Criteria
Small Group	3	12,46	very good
Field	3	13,07	very good
Total	6	25,53	very good

Table 6. Assessment Results Based on Display and Operational Media Aspects

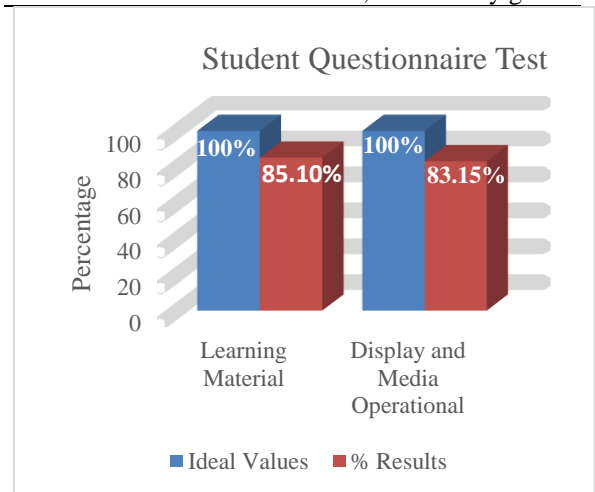|	Number of Items	Average Score	Criteria
Small Group	11	43,23	very good
Field	11	48,23	very good
Total	22	91,46	very good

Figure 3. Assessment Figure Based on Student Trial

Discussion

Android-based learning media product has characteristics namely complete range of material, practical, interesting, efficient, and flexible which can be operated anywhere and anytime as well as having evaluation of varied questions, therefore, students could repeat the material independently without restricted by time and place as well as capable of improving the memory toward materials. This statement is consistent with the research result of (T.-Y. Chuang & Chen, 2007) in which digital learning media could facilitate students in learning at any time and anywhere as well as capable of improving the motivation and memory of students because it can be used repetitively. The

trial result was consistent with what expressed by (Anggraeni & Kustijono, 2013; Jabbour, 2014; Matsuo, Barolli, Xhafa, Koyama, & Durresi, 2008; Sakat et al., 2012) in which the existence of technology-based learning media could improve the learning motivation of students and make the learning to be more attractive. Therefore, the learning will be more interesting and fun as well as capable of providing influence on learning outcomes.

Based on the results of research and development described above, thus, it can be concluded that *android-based* learning media can be used as the alternative media of biology learning and as the supplement to learning which capable of enhancing the learning motivation and cognitive achievement of High School students.

Based on the research results, there were some limitations in this research, namely: 1) not all the students own smartphone with high specification. Therefore, low-specification smartphones will have a lag during the operation. 2) the display of android-based learning media was determined by the quality and the type of *smartphone*; therefore, it cannot perform maximally.

CONCLUSION

According to the results of the conducted research and development, thus, conclusions can be drawn as follows: (1) android-based learning media which has been developed based on scientific stage with the characteristics namely interesting visualization, practical and flexible as well as having varied evaluation of questions has made the students capable of repeating the materials independently without time and place restrictions as well as improving the memory toward materials; (2) android-based learning media on the material of human respiratory system that being developed was assessed as "feasible" to be used in class learning that can be reviewed from the aspect of learning material assessment which categorized in a "Very Good" criteria, a "very good" criteria on the aspect of media assessment and also categorized in "very good" criteria based the result of trial toward students.

The product of android-based biology learning media has been tested on its feasibility by media expert, material expert, chemistry teacher, peer reviewers, and students, therefore, it is suggested toward teachers and students to utilize this software as an alternative of learning media for the material of human respiratory system for High School students.

REFERENCES

Ali, H., & Purwandi, L. (2017). *Milenial nusantara*. Jakarta: Gramedia Pustaka Utama.

Anggraeni, R. D., & Kustijono, R. (2013). Pengembangan media animasi fisika pada materi cahaya dengan aplikasi flash berbasis android. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, *3*(1), 11. https://doi.org/10.26740/jpfa.v3n1.p11-18

Calimag, J. N., Mugel, P. A., Conde, R. S., & Aquino, L. B. (2014). Ubquitous learning environment using android mobile application. *International Journal of Research in Engineering & Technology*, *2*(2), 119–128.

Chuang, T.-Y., & Chen, W.-F. (2007). Effect of digital games on children's cognitive achievement. *Journal of Multimedia*, *2*(5).

Chuang, Y.-T. (2014). Increasing learning motivation and student engagement through the technology-supported learning environment. *Creative Education*, *5*(23), 1969.

Fatmawati, E. (2010). Pergeseran paradigma perpustakaan generasi millenial. *Visi Pustaka*, *12*(2), 7–12.

Fromm, J., Lindell, C., & Decker, L. (2011). *American millennials: Deciphering the enigma generation*. Barkley, Kansas City, MO: The Boston Consulting Group and Barkley.

Hermann, M., Pentek, T., & Otto, B. (2016). Design Principles for Industrie 4.0 Scenarios. In *2016 49th Hawaii International Conference on System Sciences (HICSS)* (pp. 3928–3937). IEEE. https://doi.org/10.1109/HICSS.2016.488

Hess, S. A. (2014). Digital media and student learning: Impact of electronic books on motivation and achievement. *New England Reading Association Journal*, *49*(2), 35. Retrieved from https://www.questia.com/library/journal/1 P3-3357514321/digital-media-and-student-learning-impact-of-electronic

Jabbour, K. K. (2014). An analysis of the effect of mobile learning on Lebanese higher

education. *Informatics in Education-An International Journal*, *13*(1), 1–16.

Kinchin, I. M. (2000). Concept mapping in biology. *Journal of Biological Education*, *34*(2), 61–68. https://doi.org/10.1080/00219266.2000.96 55687

Lee, J., Lapira, E., Bagheri, B., & Kao, H. (2013). Recent advances and trends in predictive manufacturing systems in big data environment. *Manufacturing Letters*, *1*(1), 38–41. https://doi.org/10.1016/J.MFGLET.2013. 09.005

Matsuo, K., Barolli, L., Xhafa, F., Koyama, A., & Durresi, A. (2008). New functions for stimulating learners' motivation in a web-based e-learning system. *International Journal of Distance Education Technologies*, *6*(4), 34–49. https://doi.org/10.4018/jdet.2008100103

Mehdipour, Y., & Zerehkafi, H. (2013). Mobile learning for education: Benefits and challenges. *International Journal of Computational Engineering Research*, *3*(6), 93–101.

Menteri Pendidikan dan Kebudayaan Republik Indonesia. Peraturan Menteri Pendidikan dan Kebudayaan nomor 24 tahun 2016 tentang kompetensi inti dan kompetensi dasar pelajaran pada Kurikulum 2013 pada pendidikan dasar dan pendidikan menengah, Pub. L. No. 24, Peraturan Menteri Pendidikan dan Kebudayaan 5 (2016).

Pahlifi, D. M., & Nurcahyo, H. (2019). The effect of android-based pictorial biology

dictionary on students' motivation on topic of invertebrate. *Journal of Physics: Conference Series*, *1241*(1), 012048. https://doi.org/10.1088/1742-6596/1241/1/012048

Riyadi, S., & Pardjono, P. (2014). Pengembangan multimedia pembelajaran matematika berbasis komputer untuk kelas VIII SMP. *Jurnal Inovasi Teknologi Pendidikan*, *1*(2), 165–177. https://doi.org/10.21831/tp.v1i2.2527

Sakat, A. A., Zin, M. Z. M., Muhamad, R., Ahmad, A., Ahmad, N. A., Kasmo, M. A., … Kasmo, M. A. (2012). Educational technology media method in teaching and learning progress. *American Journal of Applied Sciences*, *9*(6), 874–878. https://doi.org/10.3844/ajassp.2012.874.8 78

Sutrisno, S. (2011). *Pengantar pembelajaran inovatif berbasis teknologi informasi dan komunikasi*. Jakarta: Gaung.

Tekkaya, C., Özkan, Ö., & Sungur, S. (2001). Biology concepts perceived as difficult by Turkish high school students. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *21*, 145–150.

Widoyoko, S. E. P. (2013). *Evaluasi program pembelajaran: panduan praktis bagi pendidik dan calon pendidik*. Yogyakarta: Pustaka Pelajar. https://doi.org/2013

Yahya, M. (2018). *Era industri 4.0: Tantangan dan peluang perkembangan pendidikan kejuruan Indonesia. Pidato Pengukuhan Jabatan Profesor Bidang Ilmu Pendidikan Kejuruan*. Makasar: Universitas Negeri Makassar.