I-INVERTEBRATA AS AN ANDROID-BASED LEARNING MEDIA FOR MOLLUSCS, ARTHROPODS, AND ECHINODERMS IDENTIFICATION AND ITS INFLUENCE ON STUDENTS’ MOTIVATION

Arindra Trisna Widiansyah1*, Sri Endah Indriwati2, Munzil3, Ahmad Fauzi4
1Science Study Program, PGRI Nganjuk School of Teacher Training and Education (STKIP PGRI Nganjuk), East Java, Indonesia
2Department of Biology Education, Faculty of Mathematics and Sciences, Universitas Negeri Malang, East Java, Indonesia
3Department of Chemistry Education, Faculty of Mathematics and Sciences, Universitas Negeri Malang, East Java, Indonesia
4Department of Biology Education, Faculty of Teacher Training and Education, University of Muhammadiyah Malang, Indonesia
*corresponding e-mail: arindratrisna@stkipnganjuk.ac.id

ABSTRACT

In Zoology course, students often have difficulty to identify several invertebrates. Android-based learning media is currently an alternative way of solving some problems during the learning process. Therefore, android-based learning media that assist students to identify invertebrates was developed in this study. This research method used to research and development model (R&D) developed by Borg and Gall (1983) that consisting 10 steps, that are research and data collection; planning the educational product; developing the product's preliminary form; initial field testing; the first revision of main product; main field testing; operational product revision; operational field testing; final product revision; and dissemination. The validation results from the material expert I, material expert II, and media experts were 96.6%; 94.3%; and 94.7%, respectively. That results concluded I-Invertebrata was feasible for use in learning but requires minor revision. Furthermore, the results of quasi-experimental research that was analyzed by using analysis of covariance test showed the learning motivation of students who use I-Invertebrata is significantly higher than students who do not use I-Invertebrata.

Keywords: I-Invertebrata, Invertebrate Zoology, learning motivation

INTRODUCTION

Biology is one branch of science that learns all about life (Reece, Urry, Cain, Wasserman, Minowsky, & Jackson, 2011). The learning objects in biology include all organisms, including invertebrates. Invertebrates are animals that do not have the vertebral column (Wijayanti et al., 2015). In university, invertebrate is studied in the Invertebrate Zoology course. The object of Invertebrate Zoology study includes the characteristics of morphology, anatomy, physiology, habitat and the role of invertebrates in the ecosystem. In addition, in the course, students are required to be able to identify and classify the various types of invertebrates that they found in the environment.

The tool that could be used to identify invertebrates is dichotomous keys, the tool that presents a series of statements consisting of two lines of description of the characteristics of an organism with opposite features (Randler, 2008). To understand the dichotomous keys, somebody must understand the nature and the diversity of animal shapes being identified.

To understand the principles of invertebrate identification, sometimes, course held a field study that could facilitate a contextual learning process. Contextual learning is a learning that links learning materials to real-world contexts (Fraser, Tobin, & McRobbie, 2012). Through this learning, students are empowered to think...
critically and effectively in understanding a surrounding phenomenon (Nasution & Rezeqi, 2015). However, sometimes, these activities require adequate learning media, time and cost.

The information obtained from interviews with Biology Laborans and Zoology Invertebrate course lecturer at the University of Muhammadiyah Malang (UMM) in February 2016, during the field study, students had difficulty focusing on complex invertebrate materials, thus making learning a bit saturated. One of the causes is the media used by students in assisting invertebrate identification during field study were only general maritime books and journal articles. Those learning sources just contain the description of invertebrates and the research results. This condition made teach less relevant, causing students to be less confident and less satisfied with their invertebrate identification results. This fact shows that students’ learning motivation, as well as the utilization of instructional media in Invertebrate Zoology course at the UMM, has not developed optimally.

The learning motivation is very important in the learning process (Filak & Sheldon, 2008; Kusurkar, Cate, Vos, Westers, & Croiset, 2013). Motivation also affects how many students participate in a learning activity, or how many students absorb the information/concepts taught by the lecturer. In addition, learning motivation also affects life skills (Kiswoyowati, 2011). A person who has good life skills will be able to overcome various problems of life.

Related to the interview results, it needs improvement in the learning process that involves invertebrate identification activities at the UMM. One of the efforts that could be done is to utilize innovative and contextual learning media that is able to improve the invertebrate learning process and could increase student learning motivation. One of that is a media that is able to identify invertebrates by utilizing android-based smartphone devices.

The utilization of android to support the learning process is called mobile learning or m-learning (Mehdipour & Zerekhafi, 2013). Implementation of m-learning is an attempt to overcome a number of educational problems as it allows the creation of innovation and could help students and teachers in obtaining information (West, 2013). In addition, the use of android-based applications in learning—known as blended learning—could help users (students) understand the material being studied (Husamah, 2015a, 2015b; Purwanti, 2013). Estimated, with ease of access, there is the acceleration in the use of android to overcome obstacles in the learning process (Indriwati & Dedi, 2013).

The results of further observations, through 31 questionnaires distributed by researchers in the second-semester students majoring in Department of Biology Education at the UMM who are taking the course of invertebrate courses; it is known that 84% of students have smartphone devices based on android. However, this smartphone device is mostly used for SMS, phone, or chat. This indicates that most students still use their smartphones just for social media. In addition, with so many android users, there is great potential to apply android-based learning media to those students.

Based on the information, it is proposed a research that develops the “Identifikasi Invertebrata” (I-Invertebrata) or invertebrate identification as an android-based learning media to identify Molluscs, Arthropods, and Echinoderms and its effect on students’ learning motivation. The development of I-Invertebrata is an essential study because it provides various benefits, both theoretical and practical. The theoretical use of this present study is to describe and develop the repertoire of science education and learning, especially on the development of learning media. The practical uses of this study are: 1) for students, the results of the I-Invertebrata implementation is to have a positive effect on student motivation and 2) for lecturers, the results of the study can be used as input material and one of the references for lecturers in choosing learning media.

**METHOD**

The development of I-Invertebrata based on android used a research and development (R&D) development model developed by Borg & Gall (1983) consisting of 10 steps.

**Research and Data Collection**

At this step, the information related to human resources with skills, knowledge, and media development experiences were collected as well as the research for content on the media were conducted. At this step, an inventory of Molluscs, Arthropods, and Echinoderms species in the tidal zone of Gatra Beach, Malang
District, East Java province, Indonesia was conducted.

Planning The Educational Product
Research and development (R&D) planning includes: 1) estimating funding, personnel and time; 2) formulate validator qualification; and 3) compiling research instrument consisting of student motivation questionnaire, student motivation observation sheet, expert material questionnaire and media expert and student response questionnaire.

Developing the Product’s Preliminary Form
At this step, preliminary media was developed. The preliminary media was in the form of draft or storyboard.

Initial Field Testing
Initial field testing was conducted by presenting several experts including media expert and material experts to assess the designed media. Each expert was asked to assess the design, so, it could be known about the weaknesses and the advantages of the designed media.

The First Revision of Main Product
Once the media design was validated through discussion with the experts, it could be known the weakness of the media. The weakness was then tried to be reduced by revising the design.

Main Field Testing
The test was conducted on a small scale by involving 9-second semester students of Department of Biology Education, at the UMM which were taken based on students' ability (high achievement, middle and low achievement). The reason for choosing students with different ability level was to know the evaluation of the media from the different student who has different ability level. After implemented I-Invertebrata, students were given a questionnaire to find out the students' response to the learning media.

Operational product revision
After conducting a main field testing and have known the weakness, next step was to revise I-Invertebrata in order to design the media that more perfect.

Operational field testing
I-Invertebrata was tested on a wider scale. In this step, a quasi-experimental research was conducted to find out whether the I-Invertebrata could significantly be motivated students or not. The data obtained from this step was then tested using analysis of covariance (ANCOVA). The designs at this step are presented in Table 1.

| Group | Pretest | Treatment | Posttest |
|-------|---------|-----------|----------|
| Class | T₁      | using     | T₂       |
| Control | T₁   | without   | T₂       |
| Class   |         | I-Invertebrata |         |
| Class   |         | I-Invertebrata |         |

Final Product Revision
The final media revision was conducted after operational field testing and if there were still the weakness of I-Invertebrata.

Dissemination
The dissemination was conducted if the learning media that has been tested was declared as an effective media and feasible for mass production. Dissemination conducted by presenting the learning media in research seminar and dissemination the learning media to several students from several universities.

RESULTS AND DISCUSSION

Research and Data Collection
At this step, it has been found a person who has the skills, knowledge, and experiences were willing to create a media application based on android and web server. In addition, from the inventory of Molluscs, Arthropods, and Echinoderms in the tidal zone of Gatra Beach, it was found 42 species from six classes, those were Gastropoda, Malacostraca, Asteroidea, Ophiuroidea, and Echinoidea.

Planning the Educational Product
The results of this step were: 1) the time required for the research was 6 months, the activity starts from initial observation until final media revision; 2) the material experts were senior lecturers i.e. Atok Miftachul Hudha and Agus Dharmawan, and the learning media expert was Henry Praherdiono; and 3) the instruments were student motivation questionnaire and observation sheets, material
validation questionnaire and learning media validation questionnaire.

**Developing the Product's Preliminary Form**

*a) I-Invertebrata*

“Identifikasi Invertebrata” (abbreviated to I-Invertebrata) is the name of the media that has been developed in this study. *I-Invertebrata* is an android application that serves to identify the types of Molluscs, Arthropods, and Echinoderms. The *I-Invertebrata* displays could be seen in Figure 1.

![Figure 1. The displays of I-Invertebrata](image)

b) Web Server

Web server is a website that serves to process and store data used by *I-Invertebrata* applications. When the database on the web server changes then the data on the *I-Invertebrata* application also changed automatically. The web server displays could be seen in Figure 2.

**Initial Field Testing**

The validation score from the material expert I and II was 96.6% and 94.3%, respectively, which means the material was feasible for use in learning but required minor revision. The advice from the material experts was: 1) the images should not be just black and white; and 2) all images need to have the description.

The media expert's validation score is 94.7%, which means the media is eligible for use in learning but required minor revision. The suggestion from the media expert was: 1) direct usage instructions need to be provided on the main page; 2) hardware usage instructions (smartphone screen type) and android versions (Android 4.0, Android 4.1, etc.) need to be provided; and 3) the media needs to be uploaded to the play store so that it could be downloaded en masse.

**The First Revision of Main Product**

In this step, the main product was revised. At the revision step, not all images were full colored due to there are several morphologies of invertebrates that look more contrast and clearer when the image of these invertebrates is black and white. In this step, the description has been added to all images. The usage instruction has been added to the main page. However, the suggestion from the media expert that advice to upload the media to the play store was not conducted due to limited of funds and time.
Main Field Testing
The score of student responses to I-Invertebrata was 88.3% which means media has been feasible and can be used in learning but required little revision. The total students' responses to the I-Invertebrata are shown in Table 2.

Figure 2. The displays of the web server

Students' comments on I-Invertebrata were generally said that I-Invertebrata was an interesting media and helpful in identifying Molluscs, Arthropods, and Echinoderms. But,
there was some point that needs to be improved, such as the need to add an explanatory image to each key determination in order to enable the student to understand every key determination. Figure 3 is the documentation of the main field testing step.

Table 2. Results of student responses to learning media

| No. | Aspects                      | Percentage (%) | Category |
|-----|------------------------------|----------------|----------|
| 1   | Attractiveness               | 89             | Feasible |
| 2   | Clarity of material presentation | 85             | Feasible |
| 3   | Efficiency                   | 91             | Quite Feasible |
| 4   | Interactivity                | 88             | Feasible |
|     | **Average**                  | **88.3**       | **Feasible** |

Beside from the observation sheet, the students’ learning motivation data was also obtained through pretest and posttest. The mean pretest score of students’ learning motivation in the control class was 76 whereas the post-test score was 74. The mean score of students’ learning motivation in the experimental class was 75 whereas posttest score was 77. The graph of students' motivation mean score is shown in Figure 4.

**Figure 3.** The main field testing step (Source: Authors’ research documentation)

**Figure 4.** The graph of pretest and posttest score in experimental and control class

**Operational Product Revision**

At this step, an explanatory image of the determination key to enable the student to understand every key determination were added.

**Operational Field Testing**

Based on students' learning motivation from observation sheet, the students’ learning mean score in experimental class was 74%, whereas in control class was 64%. From the data, it could be seen that during the learning process, students who use *I-Invertebrata* appear more motivated in following the learning process when compared with students who do not use *I-Invertebrata*.

Then, the data were analyzed using ANCOVA. The result of ANCOVA test could be seen in Table 3.

**Table 3.** The summary of ANCOVA test result

| Source            | Type III Sum of Squares | df | Mean Square | F     | Sig.  |
|-------------------|-------------------------|----|-------------|-------|-------|
| Corrected Model   | 789.3                   | 2  | 394.7       | 11.2  | 0.000 |
| Intercept         | 294.1                   | 1  | 294.1       | 8.4   | 0.006 |
| Pretest Motivation| 650.4                   | 1  | 650.4       | 18.5  | 0.000 |
| Class             | 195.7                   | 1  | 195.7       | 5.6   | 0.022 |
| Error             | 1863.1                  | 53 | 35.2        |       |       |
| Total             | 320471.2                | 56 |             |       |       |
| Corrected Total   | 2652.4                  | 55 |             |       |       |

Based on the result, F value was 5.567 with p-value was 0.022, p-value < α (α = 0.05). Thus, *H*0 was rejected and the research hypothesis that states there are significant differences between students’ learning motivation in the experimental class with students in the control class was accepted. The adjusted mean score in experimental class was 77.212 whereas control class was 73.458. Thus, the learning motivation of students who use *I-
Invertebrata is significantly higher than students who do not use I-Invertebrata.

The student response score on I-Invertebrata was 80% which means media was feasible and could be used in learning but still required minor revision. Students' comments generally stated that I-Invertebrata were attractive, innovative, and useful for identifying invertebrates. Furthermore, students stated I-Invertebrata were more reliable. However, there were some notes that need to be fixed, such as the visual displays were less interesting, the menu was not directly displayed on the main page, and need to be added a share menu with the aims the students could share the identification information to the other friends. Figure 4 is the documentation of the operational field testing step.

![Image](a)

**Figure 4.** The operational field testing step in experimental class: (a) identification process and (b) identification results presentation (Source: Authors' research documentation)

Final Product Revision

In this step, several revision have been conducted, such as revising the display of icons, backgrounds, menus that directly displayed on the main page, and adding the share menu that aims to enable students to share their identification results to social media (email, Facebook, Twitter, and the other social media), as well as adding the contact menu so that students could give a criticism or suggestions to developers.

Dissemination

This step was conducted through national research seminar and dissemination the learning media to several students at the UMM and Universitas Negeri Malang (UM). In this research, I-Invertebrata as a learning media that could improve students' learning motivation in Zoology Course has been developed. The findings obtained in this study is I-Invertebrata able to improve student's motivation to learn. This finding is in line with some previous researchers who conducted research on the positive impact of learning media on the learning process (Alqahtani & Mohammad, 2015; Lee, 2015). Alqahtani and Mohammad (2015) research show that the use of Say Quran which is an android-based learning media has a relationship with the appearance, satisfaction, and behavior of students, whereas, in Lee's research, the use of mobile phone can increase the academic motivation of learners.

The characteristics of I-Invertebrata that use original images made I-Invertebrata as an interesting learning media. Furthermore, I-Invertebrata is an easy operation media. Those two factors contribute to improving students' attention.

This explanation is in line with Nugrahanii (2007) that stated the use of the image in learning media is an effective way to improve students' absorptive capacity and improve the students' understanding of the lessons. Moreover, the use of the image as a learning media is more effective to convey information or messages as well as more facilitate students during learning something (Arguel & Jamet, 2009). Pan and Pan (2009) also reported the presence of images can make it easier for students to understand what they are reading.

I-Invertebrata as an android-based learning ....
In addition, the use of key determination using Bahasa Indonesia led learning to more effective. This condition also led the confidence of the students to increase. Students were more understanding of the material and were more confident with their invertebrate identification results. This self-confidence is one of the important characteristics to achieve optimal learning achievement (Salirawati, 2012). Students who are more confident about a subject generate more motivation during the learning process.

Based on this study, I-Invertebrata is the learning media that useful for improving Invertebrate Zoology Course process. In addition, in the future, the presence of I-Invertebrata could also facilitate the practice of Zoology practical activity based on authentic-based research. The idea to design Zoology Course based on authentic-based research is necessary due to in the last few decades, various research has recommended lecturing activities that facilitate students to do authentic-based research (Fauzi, Corebima, & Zubaidah, 2016; Fauzi & Ramadani, 2017; Widowati, Nurohman, & Anjarsari, 2017). In these learning, students will design and conduct their own research, meanwhile, the lecturer only provides the basic themes for their research. With the presence of I-Invertebrata, students will more easily perform their research activities when their research procedure require identifying of various invertebrates.

CONCLUSION

Students’ motivation is one factor that plays an important role in the success of the learning process. When a lesson becomes tedious or matter becomes increasingly difficult to understand, the motivation of students tends to decrease. One alternative solution to handle the condition is by presenting learning media into the learning process.

I-Invertebrata is an android-based media that has been developed in this study. The validation results from material and media experts concluded I-Invertebrata was feasible for use in learning. Moreover, based on quasi-experimental research that has been conducted at operational field testing test, I-Invertebrata has been proved could improve students’ learning motivation in Invertebrate Zoology Course at the UMM. I-Invertebrata could be the alternative way to improve the learning process of Zoology course.

It is recommended for lecturers to use I-Invertebrata as the solution of the obstacle when student face difficulty in identify invertebrates. However, I-Invertebrata still needs to be refined to be more perfect. Related to that, The database on the web server needs to be added by conducting an inventory study on the other beach or collecting data generated by the other inventory reports from other researchers.

REFERENCES

Alqahtani, M., & Mohammad, H. (2015). Mobile applications’ impact on student performance and satisfaction. Toolset The Online Journal of Distance Education and E-Learning, 14(4), 102–112.

Arguel, A., & Jamet, E. (2009). Using video and static pictures to improve learning of procedural contents. Computers in Human Behavior, 25, 354–359. https://doi.org/10.1016/j.chb.2008.12.014

Borg, W. R., & Gall, M. D. (1983). Educational research an introduction. New York, USA: Longman.

Fauzi, A., Corebima, A. D., & Zubaidah, S. (2016). The utilization of ferns as a model organism for studying natural polyploidization concept in the genetics course. In International Conference on Education (pp. 51–58). Malang: Universitas Negeri Malang.

Fauzi, A., & Ramadani, S. D. (2017). Learning the genetics concepts through project activities using Drosophila melanogaster: a qualitative descriptive study. JPB (Jurnal Pendidikan Biologi Indonesia), 3(3), 238–247. https://doi.org/10.22219/jpb.v3i3.4540

Filak, V. F., & Sheldon, K. M. (2008). Teacher support, student motivation, student need satisfaction, and college teacher course evaluations: testing a sequential path model. Educational Psychology, 28(6), 711–724. https://doi.org/10.1080/01443410802337794

Fraser, B. J., Tobin, K. G., & McRobbie, C. J. (Eds.). (2012). Second international handbook of science education, volume 24. Dordrecht: Springer Science+Business Media B.V. https://doi.org/10.1007/978-1-4020-9041-7
Husamah, H. (2015a). Blended project based learning: Metacognitive awareness of biology education new students. *Journal of Education and Learning, 9*(4), 274–281. https://doi.org/10.11591/edulearn.v9.i4.2121

Husamah, H. (2015b). Thinking skills for environmental sustainability perspective of new students of biology education department through blended project based learning model. *Jurnal Pendidikan IPA Indonesia, 4*(2), 110–119. https://doi.org/10.15294/jpii.v4i2.3878

Indriwati, S. E., & Dedi, S. (2013). Accelerating the use of android technology for teaching and learning science in higher education. In *Proceeding International Seminar on Mathematics, Science, and Computer Science Education Indonesia*. Bandung: Faculty of Mathematics and Science Education, Indonesia University of Education.

Kiswoyowati, A. (2011). Pengaruh motivasi belajar dan kegiatan belajar siswa terhadap kecakapan hidup siswa (studi tentang pembelajaran berorientasi kecakapan hidup di SMK Negeri 1 Losarang Kompetensi Keahlian Agribisnis Tanaman Pangan dan Hortikultura-Budidaya Cabe Hibrida). *Jurnal Pendidikan Pendidikan, Edisi Khus(1), 120–126.

Kusurkar, R. A., Cate, T. J. T., Vos, C. M. P., Westers, P., & Croiset, G. (2013). How motivation affects academic performance: a structural equation modeling analysis. *Adv in Health Sci Educ, 18*, 57–69. https://doi.org/10.1007/s10459-012-9354-3

Lee, M. K. (2015). Effects of mobile phone-based app learning compared to computer-based web learning on nursing students: pilot randomized controlled trial. *Healthcare Informatics Research, 21*(2), 125–133. https://doi.org/10.4258/hir.2015.21.2.125

Mehdipour, Y., & Zerehkafi, H. (2013). Mobile learning for education: benefits and challenges. *International Journal of Computational ..., 3*(6), 93–101 (251–259). https://doi.org/10.1080/87567555.2011.604802

Nasution, M. Y., & Rezeqi, S. (2015). Application of contextual learning to improve critical thinking ability of students in biology teaching and learning strategies class. *International Journal of Learning, Teaching and Educational Research, 11*(3), 109–116.

Nugrahani, R. (2007). Media pembelajaran berbasis visual berbentuk ular atau yang untuk meningkatkan kualitas belajar mengajar di sekolah dasar. *Lembaran Ilmu Kependidikan, 36*(1), 351–44.

Pan, Y., & Pan, Y. (2009). The effects of pictures on the reading comprehension of low-proficiency Taiwanese English foreign language college students: an action research study. *VNU Journal of Science, Foreign Languages, 25*, 186–198.

Purwanti, I. (2013). Perancangan aplikasi pembelajaran huruf hijaiyah berplatform android untuk Madrasah Baca Tulis Al Quran Al-Fattah Desa Widodaren Kabupaten Ngawi. In *Seminarp Riset Unggulan Nasional Informatika dan Komputer* (pp. 123–130). Sumbawa Besar, Nusa Tenggara Barat, Indonesia: FTI Universitas Samawa.

Randler, C. (2008). Teaching species identification - A prerequisite for learning biodiversity and understanding ecology. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(3), 223–231.

Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2011). *Campbell Biology, Ninth Edition*. San Francisco, USA: Pearson Benjamin Cummings.

Salirawati, D. (2012). Self-confidence, curiosity, and entrepreneurship: three important characters for the students. *FMIPA Universitas Negeri Yogyakarta, 2*, 213–224.

West, D. M. (2013). *Mobile learning: transforming education, Engaging Students, and Improving Outcomes*. Brookings, USA: Center for Technology Innovation.

Widowati, A., Nurohman, S., & Anjarsari, P. (2017). Developing science learning material with authentic inquiry learning approach to improve problem solving and scientific attitude. *Jurnal Pendidikan IPA Indonesia, 6*(1), 32–40. https://doi.org/10.15294/jpii.v6i1.4851

Wijayanti, E., Fauzi, A., Widiansyah, A. T.,...
Mustofa, Z., Setyanto, A., Sukoco, R. M., … Fadilah, R. E. (2015). The inventory of aquatic macroinvertebrates in various waterfall in east region of Malang, East Java. In E. L. Arumingtyas (Ed.), *Proceeding of 6th ICGRC* (pp. 150–153). Malang, East Java, Indonesia: Department of Biology, Faculty of Sciences, Brawijaya University.