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Developing Android-Based Mobile Learning On Cell Structure And Functions Lesson Subject Topic To Optimize Grade XI Students' Cognitive Comprehension

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Abstracts: The objective of this study is to develop an android-based mobile learning media for Cell Structure and Function lesson subject in compliance with ADDIE development mode. The developed mobile learning takes in general explanation, learning objective, animal and plant cells material explanation complemented with activities and cell exploration clip, evaluation questions, dictionary, and technical guidance. In addition, the reviews of media expert, material expert, and academicians have shown that the developed media is valid. Also, the response of students has proven that the practicality rate of the developed media is 84.65%-100% and the classical pass of Abstrl cognitive tests upon learning by way of the developed media is equal to 84.61%.

Key Words: learning media, mobile learning, android system, cell

Abstrak: Tujuan penelitian adalah mengembangkan media *mobile learning* berbasis *android* pada pembelajaran Struktur dan Fungsi Sel yang mengacu pada model pengembangan ADDIE. *Mobile learning* yang dikembangkan terdiri dari penjelasan umum, tujuan pembelajaran, pemaparan materi sel hewan dan tumbuhan yang dilengkapi aktivitas dan video jelajah sel, soal evaluasi, kamus, dan petunjuk penggunaan. Penilaian ahli media, ahli materi, dan praktisi pendidikan menunjukkan bahwa media yang dikembangkan valid. Tanggapan siswa menunjukkan bahwa tingkat kepraktisan media hasil pengembangan sebesar 84,65%-100% dan ketuntasan klasikal tes kognitif setelah pembelajaran menggunakan media yang dikembangkan sebesar 84,61%.

Kata kunci: media pembelajaran, *mobile learning*, sistem *android*, sel

One of the Biology subject topics for XI graders is Cell Structure and Function. The apprehension on the cell structure and function is eminently important to comprehend as cell is the foremost fundamental concept in Biology, but nonetheless is unusually challenging to teach to students (Carlan et al., 2014). Observing cell structure and the occuring process clearly and itemizedly calls for electron microscope whose price is very pricey and there is no school having that instrument. This gives rise to the difficulty in presenting reall cell to students amid their learning process (Wijaya, 2006). From the observation and interview carried out to three Biology teachers in MAN Pasuruan, it was discovered that to resolve that issue, the teachers used artifical media in the form of torso. With regards to the respondents, torso was capable of helping out students to apprehend cell structure, but nevertheless they had yet to be able t explicate the process inside. The majority of the students (94.87%) shared a pereception of that cell structure and function topic was still considerably difficult to comprehend due to being abstract and crammed with recitation similarly reported by Wijaya (2006), Cimer (2012), Mahardika (2014), and Carlan et al. (2014). This perception impacted on the subsidence of the students' cognitive learning result (Cimer, 2012). The result of the questionnaire has also proven that there was only 5.13% of MAN Pasuruan students who possessed good comprehension on cell structure and function topic.

The phenomenon which has traits of being microscopic, abstract, and related to the process requires dynamic model explanation able to delineate the abstractness and the dynamics of those phenomenons

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by way of animation and multimedia (Muchson, 2013). In fact, cell function and structure learning media have been prevalently developed by some researchers, some of them are Azizah (2011), Khikmah (2013), and Adinda (2013). The shortcoming of this media type is its lack of flexibility to carry or to move places as it requires computer device or notebook resulting in the restraint of students activities. Flexible media facilitates students to learn anywhere and anytime so that students learning frequency can be higher bringing a pass to the high students retention (Lubis & Ikhsan, 2015). One of the hardware that can be developed as learning media with those criterions is smartphone. This type of smartphone is equipped with the feature for mobile learning (Squire, 2009; Meister, 2011; Behera, 2013). Mobile learning is more familiar and preferred by students with the tendencies of selecting familiar technology (Yusri & Robert, 2013). This mobile learning idea development is also backed up with the fact that all XI graders in MAN Pasuruan have smartphone and onle few have PC or notebook.

The developed mobile learning in this study uses smartphone with android-operation system. This was based from facility availability in MAN Pasuruan, the strength of android-operation system, and its popularity. MAN Pasuruan students are prominently to use android operation system (53.8%) in comparison to other operation systems Java, Blackberry, and Symbians. In addition, Android has the edge on its open-source operation system providing opportunity for the users to develop aplication feature in respect of their needs (Safaat, 2011; Tamhane et al., 2015).

With regard to the occuring problem in cell structure and function lesson subject and a big number of XI graders in MAN Pasuruan who have smartphone with android operation system along with its edges on mobile learning media, thus, android-based mobile learning media for that lesson topic is developed.

METHOD

The procedure and the developmet of the research were in compliance with ADDIE development model (Branch, 2009), with the steps as follows.

The first step was analysis covering problem identification, need analyses, and task analyses. In problem identification activity, it was figured that cell structure and function subject topic was such tough topic for students to comprehend. Over need analysis activity, it was discovered that learning media needs presenting about the dynamic and abstractness of cell structure and function could be used flexibly anywhere and anytime so that the students could sap the terms more. In task analysis activity, the analyses on main competence, basic competence, and competence achivement indicator were carried through later made as references for mobile learning media.

The second stage was design taking in the making of media content outline (GBIM), material descriptions (JM), storyboards, and flowcharts functioning as guides for developing android-based mobile learning media that would be developed.

The third stage was "develop" stage which included media creation activities by way of Adobe Professional CS6 with Action Script 3 programming languages, Adobe Illustrator, Adobe Photosop, and Camtasio Studio 7. Learning media that had been developed then furtherly validated by material experts, media experts, and academicians to identify Its shortages The media products were subsequently revised in regards with suggestions and comments from media experts, materials experts, and academicians. Learning media products that had been revised and then validated again so that all components of learning media could be deemed valid and applicable/able to be tested to students.

The fourth stage was "implementation" covering the formation of learning implementation plan (RPP) and cognitive test, the installation of mobile learning media application having been developed in smartphone, and eventually the instrument test on 26 XI graders from Natural Sciences program in MAN Pasuruan as research subjects.

The fifth stage was "evaluate" an evaluation of the product to verify whether the product was valid or not. In result, product improvements were performed in concer of validation results from media experts, material experts, education practitioners and test/trial on the designated users.

The used data collection instruments in the development of this instrument comprised of expert validation sheets, student response questionnaires, and evaluation sheets. Evaluation sheet in the form of cognitive tests distributed to students upon having learned by way of the media that had been developed to find out the effectiveness of the media.

The data types in this research and development were qualitative and quantitative data. The qualitative data was generated from yes and no statements on every aspect of assessment, responses, suggestions, and criticism obtained from media experts, material experts, educational practitioners, and user goals on

the developed product. Quantitative data in the form of percentage of students who answered positive (yes) and the comprehension percentage by classical evaluation value at the end of learning. Qualitative data would be analyzed both descriptively and qualitatively. The data in the forms of student responses and evaluation values were classically calculated in percentage formula. Criteria for validity, practicality, and effectiveness in concer of Akbar (2013). Media were deemed valid and practical shpuld they be positive (yes) for each indicator of the aspect of the media at least 80%, except for the validation of the material expert must be 100% with the objective that of there was no wrong material. Media were said to be valid if the percentage of classical passing grade hit at least 80%. Minimum completion criterion (KKM) was $\geq$ 75 (according to KKM at school).

RESULTS AND DISCUSSIONS

The generated product of this study is in the form of android-based mobile learning media for cell structure and function subject topic of XI Graders in reference of the Basic Competences 3.1 and 4.1 in 2013 Curricula. This learning media was an android-based application Adobe AIR 3.2 that could be installed on all kinds of smartphone with android operation merging multimedia components of text, picture, audio, and video.

The moment on which this application is accessed there will be a brief popping up explanation as to Biocell Mobile Learning application which then automatically directs to the main menu. The developed media are also complemented with technical guidances in means of self-accessibility of the students whilst inside or outside classroom under the supervision of teacher. On main page, there are menus of LEARNING OBJECTIVE, MATERIALS, EVALUATION, REFERENCES, PROFILES, and DICTIONARY (Figure 1). LEARNING OBJECTIVE menu presents skills indicators that must be attained by the students by means of helping them out focused on the Basic Competence. Material explanation focuses on the conceptual comprehension building, preceeded with a video explanation as to how animal and plant cells are observed using light microscope and electron microscope. Upon the background explanation finishes, there will be some buttons of ANIMAL and PLANT CELLS, ACTIVITIES, and VIDEO popping out on the screen. In animal and plant cells menu, the structures of animal and plant cells as well as organelles learnings are more emphasized. Students can learn the structure of animal and plant cells by way of clicking the buttons having cell and organel sections labels (Figure 2). Even more, explanation of this cell structure in the form of video tutorials like camtasia studio 7 which is also complemented with text under it as the main concept that must be mastered (Figure 3).

On the ACTIVITY section, students can evaluate their abilities in a fun way through filling in the description of animal and plant cell parts and organelles (ACTIVITY 1-3), differentiating the cell structure and function by drag and drop (ACTIVITY 4), and pairing organelles with their functions (ACTIVITY 5) which can be checked the truth of the answer by clicking the check button (Figure 4). This menu provides flexibility to students to interact with the media learning and maximize the use of the senses, especially kinesthetic (hands). The VIDEO menu emphasizes the cell and process functions that occur inside the cell through a tutorial strategy that invites students to explore the cell as a whole (Figure 5). The material review is rested from relevant and valid references to ditch some concept errors that can be seen on the reference menu.

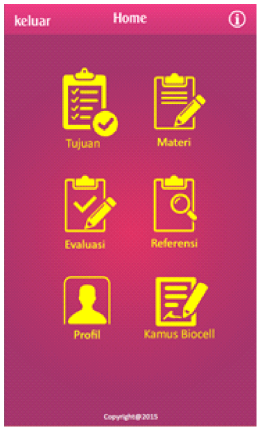

Figure 1. Main Menu Screen

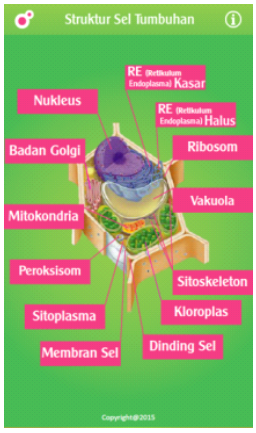

Figure 2. Material Options Screen

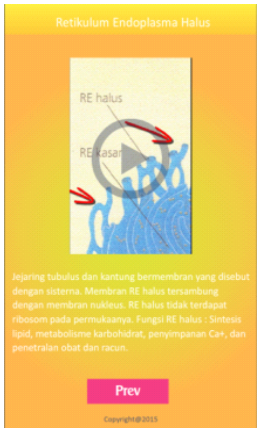

Figure 3. Material Explanation Screen

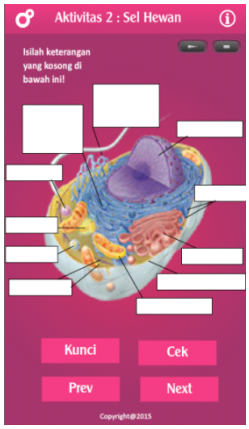

Figure 4. Activity Screen

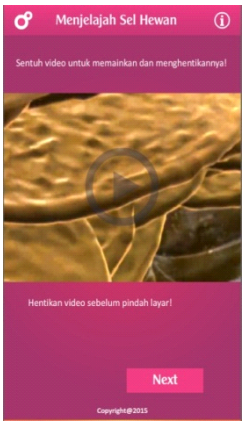

Figure 5. Cell Exploration Video Screen

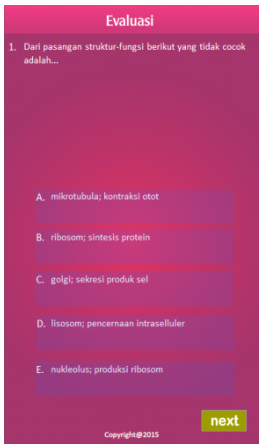

Figure 6. Evaluation Screen

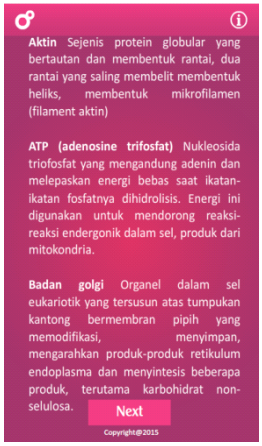

Figure 7. Dictionary Screen

Students can also repeat the displayed topics or sections in case they do not understand the material previously learned by clicking the "prev" button.

The EVALUATION menu is also designed to be interactive by the provisions of multiple choice questions that the students must fulfil in order to evaluate their understanding on the material they have learned through clicking one of the answer buttons. Student' answers will be responded by the media at the end of this menu and completed with the obtained scores. Students are also able to know the correct answer through the DISK button menu that only turns up on which the students have done the evaluation to finish. In addition to the elements of interactivity, the advantages of evaluation on this medium are questions and the choice of answers given to students will vary, this is set out to prevent students from memorizing the answers (Figure 6). The DICTIONARY menu facilitates students to learn important terms that must be quickly known (Figure 7).

The results of media expert validation on this medium are positive (yes) for each indicator from each component on the aspects of software engineering and visual communication. These results signify that the android-based mobile learning media is already feasible in terms of software and visual communication aspects. Furthermore, the results from material expert validation as to this media are also positive (yes) for each indicator from each component in regards with

curriculum and material content aspects. These results mean that this learning medium is feasible in term of learning design aspects. Field practitioners, also, share positive (yes) responses to each indicator of each com-ponent on the aspects of curriculum, visual communica-tion, and material content referring that the learning media of this android-based mobile learning is feasible in the matters of visual communication and learning design.

Amid the test all respondents (students) gave positive responses (yes) on almost all components of the aspects of software engineering, visual communication, material, and curricula, unless on the indicator ("menu selection feasibility") on the component "usability" positive response was 96.15%, the indicator ("size and font compatibility") on "visual" component, the positive response was 96.15%, the indicator ("button design visual appeal") on "navigation icon" component, the positive responses was 88.46%. On the indicator ("display attractiveness") on the component "simple and attractive" the positive response was 84.65%. In addition, on the indicators (" media that can be used anywhere and anytime"), ("material presentation on the media that enables students to study at home"), and ("media can make students learn in concert with learning speed and intensity") on the component "completion" each of positive response was 88.4%. In accordance with the test completed test result, android-based mobile learning media was practical.

In the trial there were several shortages found as follows. (1) Not all students had a device that could support this media, the learning, thereby, was performed in groups (2 to 3 people) for one android. Learning under such conditions, besides, was less effective in view of the fact that each student had different learning speeds. (2) There was a tendency that students opened other applications such as social media other than this medium over the learning process. (3) Installing media on android required Adobe AIR appli-cation so it took quite a long time to install. (4) There was a tendency for students to directly access the ACTIVITY menu without learning the material through the material section of ANIMAL CELL and PLANT CELL (the usage was not in order).

The result on the aspect of software engineering and visual communication tests was 84.65% – 100% signifying that in terms of its usability and design of the developed media was very feasible and interesting to encourage student learning motivation (Miao, 2012). This could be sighted from the test results that 100% of students responded positively (yes) on the indicators of educational value in the curriculum aspect showing that android-based mobile learning media on learning the structure and function of these cells could make the learning atmosphere become more interesting and able to streamline communication within the learning process so that students were more motivated in the learning process (Miao, 2012, Califag and others, 2014, Hess, 2014, Calimag et al., 2014) and they could have deeper comprehension of the material (Sari & Sugiyarto, 2015). A number of research results indicated that students who followed learning with ICT-based learning media had high motivation bringing a pass on high cognitive learning outcomes in response (Tella, 2007; Sakat et al., 2012; Handhika, 2012; Yektyastuti & Ikhsan, 2016; Anggraeni & Kustiyono, 2013). The results of the test proved that the presentation of the material on the developed media was easy to understand and clear (100%). This was evident from the results of the final learning evaluation that showed mastery learning with KKM ≥ 75 in the classical 84.61% with an average of 81.07. These results, also, showed that the learning media of mobile learning based on android was effective to improve students' cognitive learning outcomes (Ally and others, 2015; Chuang & Chen, 2007; Jabbour, 2014).

In addition to several abovementioned edges, other strengths are its high compatibility (can be installed on the type, version, and resolution of the android screen) and developed offline-based to make this media can be used in place or in schools that are still out of the coverage of Internet network, MAN Pasuruan and can surpredd the pricey cost because without in-ternet access (non-internet or non-data package use).

This android-based mobile learning media also has application memory shortage consuming too much capacity of 98 MB resulting in such quite load within smartphone' internal storage and sometimes the media display is not that good on some smartphone with low specification (version) and small screen. Accordingly, the problem can be resolved by way of using smartphone android with minimum specification of 768 MB RAM and 4 inch minimum screen so that the media can work properly.

CONCLUSIONS

This research has successfully developed android-based mobile learning media in respect of cell structure and function subject topic for XI graders having also catered all indicators on the aspects of

software, learning design, and visual communication. (2) With regard to the feasibility study over the assessments of material expert, media expert, and field practitioner as well as practicality and effectiveness test through pilot testing, the development has been proven to be appropriate, practical, and effective to use for XI graders' cell structure and function subject topic.

The researcher' suggestions in relation to the employment of this development result are addressed as follows (1) the learning activity had better be carried out with every student uses one android smartphone to make the learning run more effective, (2) teacher ought to remind students not to access other application whilst making use of the learning media to make the learning go well, (3) teacher ought to remind the students to read technical guidance so that the learning can run well, (4) teacher should remind and ensure that mobile learning and Adobe AIR applications have been installed in students' smartphones, (5) teacher can use this mobile learning media and combine it with scientific approach learning or other learning models for instance Team Games Tournament (TGT) dan Thinks Pair Share (TPS), (6) teacher should use instructional media sequentially from activity 1 to activity 5, (7) teachers should encourage students to frequently use these learning media in various places and times as it can put up students' comprehension and retention of the presented materials, (8) students should use this instructional media on android phone with minimum 768 MB RAM and minimum 4 inch screen, (9) students should also use textbooks as a companion to complement some information that may not be covered in the learning media, (10) teachers should display instructional media with LCD in front of class during learning process.

The researcher' suggestion as to the dissemination of this development result is that the dissemination of this learning media product can be brought off by ways of socialization process and uploading it to Google Play Store. The socializatio process of this product, furthermore, can be undertaken through educational exhibitions, seminars, educational institutions, education offices, and learning media competitio. The cooperation of others are called for, such as the ministries of education and culture, the ministry of research, technology, and higher education, and educational institutions/schools/private sector willing to cover the cost of Google Play Store account registration so that this learning media can be uploaded and can be downloaded by Android users in every nook and cranny of the world. Another alternate is to upload this learning media on a free servers or education sites.

The researcher's suggestion in regard with further development is explicated as follows. (1) Developing mobile learning learning media that has database/ data bank that can log any activities and any results of student evaluations. (2) Developing mobile learning learning media with materials that can be automatically updated from the server, but the material can still be accessed by students offline. (3) Developing learning media with evaluation questions that provide facilities for users to change the answer choices. (4) Using this media as a learning instrument in experimental research or classroom action research (PTK) and tested on a wider scale to refine the quality of this learning media. (5) Learning media is developed through adding material covering all cell materials and other materials in grade XI. (6) Material structures of this mobile learning media as well as cell functions in online form is to be developed. (7) Material structures of this mobile media and the functions of cells in various platforms for instances J2ME, Blackberry, iOS, Windows Phone, and any others to accommodate students who use other variants of cell phones other than android can also be further develop.

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