The development of android-based science learning media on human eyes topic

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Abstract. Either field or literature studies recommended the need of learning media on human eyes topic which present learning objectives, materials, evaluations, and assessments. Also, the learning media should be able to support independent, interactive, and fun learnings. Learning media is developed through the steps of research and development. The developed product was an android application named “Human Eye Optics.” The product characteristics were: providing menus: learning objectives, materials, simulations, exercises, and evaluations; each menu has sub-menus such as eye parts, viewing process, and eye disorders; having five interactive and communicative simulation submenus; materials are described attractively through the use of full-color text and images; the teacher can use it as a learning device since it has covered learning objectives, materials, quizzes, exercises, and evaluations with assessment; the application could be referred to as an independent and repeatable learning source; and usable at anywhere and anytime. The product feasibility was categorized as “excellent” with a score of 4,60. The same thing went with the practicality which belonged to the “excellent” category with a score of 4,51. The effectivity achieved “high” with an n-gain of 0,76 while the average student activity was 89,02% and declared to be “very good.”

1. Introduction
One of the principal subject matters in the integrated science course of Junior High School grade VIII is human eyes. This subject intends to confirm the Basic Competencies of the 2013 Curriculum which reads: “Analyzing the nature of light, the formation of images on flat and curved fields, and its application to explain the process of human vision, insect eyes, and the working principle of optical devices.”

Basic Competencies are knowledge, skill, and attitude every student should achieve to evidence that s/he has been capable of mastering the established Competency Standards. This emerges a responsibility of junior high school teachers, particularly for the grade VIII to design learning in such a way that their students can analyze and understand the application of the light property and the image formation concepts in the process of human vision.

A field study conducted in SMP Negeri 8 Salatiga on human vision revealed the demand for feasible, practical, and effective learning media to (1) present learning objectives and materials in accordance with the Basic Competencies; (2) display abstract concepts such as the course of light when the vision process of an object occurs; (3) show the structure and function of the human eyes; (4) present differences between normal impaired eyes; and (5) provide quizzes, problem training, and evaluations in the context of student competency testing. Also, this learning media is expected to...
support (6) independent; (7) interactive; and (8) fun learning processes. This research aimed at developing a feasible, practical, and useful android-based science learning media on human eye topic.

The learning process is closely related to the selection and use of appropriate learning models, strategies, methods and media. The relevance of instructional media and technology cannot be avoided in teaching and learning activities [1]. Learning media are useful for stimulating students' attention, thoughts, feelings, abilities, and skills to drive the learning process. One alternative solution that is relevant today is the use of digital technology to disseminate information and communicate as a basis for the development of instructional media. The rapid development of the media industry and multimedia technology should make educators try to use it for learning purposes [1].

Technology can be defined as something that can create, store or process data, and includes touch screen devices [2][3]. Touch screen device technology can currently be in the form of a smartphone that can be connected to the internet to download applications [4]. Although, some studies report concerns that internet-based touch screen technology has the potential to consume student time and replace more traditional forms of play, which some believe is more valuable [3][5][6][7]. However, student learning styles and multiple intelligences can be connected through visual literacy [8]. In addition, the effectiveness of learning can be achieved through the development of strategies that apply a blend of current trends and the advantages of digital learning [9]; so that it can have a positive impact on student motivation [10]. The positive impact of the use of technology in learning has been stated by various studies. The use of computer-based technology as a learning medium has a positive impact on increasing student understanding of learning, even through various learning styles [11,12]. Anyhow, effective integration of cellular technology into learning processes may only be successful if a proper teaching method is picked. Technology usage in learning environments with appropriate guidance and monitoring enables students to acquire the skills needed for lifelong learning [13].

Cellular-internet communication devices are nowadays trends in mobile learning [14]. Technology-based mobile learning allows students to quickly obtain information and learning materials to result in the significant increase in students' competencies. On the other hand, the use of such learning permits teachers in controlling information, materials, and tests from anywhere at any time [15].

By the time being, the selection of Android as an operating system software in developing mobile learning is very appropriate as the use of Android-based mobile learning could enhance students' learning independence and conceptual understanding [16]; increasing diagrammatic and argumentative competence in physics learning [17]; and be useful to learn, answer quizzes, see images and video galleries as well as do puzzle games [18].

2. Methods

Sugiyono's (2017) Research and Development method and steps were adopted in this research and shown in Figure 1. The research product was an Android application entitled “Human Eye Optics,” which has been through a series of validation and trial.

![Figure 1. Research steps](image-url)

The product assessment of feasibility and practicality was carried out by materials experts, media experts, and practitioners (teachers). The product effectivity was measured using the N-gain factor of
human eye concepts mastery and the positive activities of students shown during observations. This research was performed in SMP Negeri 8 Salatiga. The research subject was homogeneous 30 VIII grade students. The dependent variable was the students’ concept mastery of human eyes while the independent variable was the use of the research product.

This research is said to be successful if: (1) the product is declared feasible or at least achieves the category of “acceptable”; (2) the product is declared effective at the “moderate” n-gain score, and the students show positive activities which categorized as “good”; and (3) the product is declared practical when the validation result got the “acceptable” category.

3. Results and Discussion

The field study was conducted employing interview, documentation, and questionnaires technique in SMP Negeri 8 Salatiga. Meanwhile, the literature study was done by analyzing sources about the 2013 curriculum, learning media, and way of creating Android-based applications. This stage resulted in a conclusion that a feasible, practical, and effective Android-based learning media on human eyes is required by junior high school students, especially students of SMP Negeri 8 Salatiga.

The data collection stage consisted of concept making, gathering, and selecting learning materials to be put in an android application. In spite of those, several other activities contained in these stages were: (1) identification of basic competencies; (2) analysis and establishment of basic competencies; (3) determining the successful indicators; (4) creating test item standards; (5) development of learning strategies; and (6) development and selection of learning media. A storyboard was first created based on the compiled materials before it was designed as an Android application. This storyboard was called the preliminary design.

The preliminary design was validated by the experts of materials, media, and practitioners. Their suggestions were referred to revise the product. The product that has been through the validation and revision stage was then tested on a limited scale. The application experienced three-time revisions before carrying out the large scale trial which included 30 students of SMP Negeri 8 Salatiga.

Suggestions for product improvement proposed by the validators and respondents during the validation and trial stage were referred while final revision was being performed just before the massive production stage. The final product is a product that has been validated by materials experts, media experts, and practitioners, and has undergone extensive trials. The mass production of this development was done by uploading the Android software file to Google Play Store.

The homepage menus are (1) learning objectives, (2) material, (3) simulation, (4) problem training, and (5) evaluation. This menu display is shown in figure 2. Figure 3 is the materials page comprising some options like eye parts, viewing processes, and eye disorders.

Figure 2. Homepage display  
Figure 3. Page of learning materials

Figure 4 is the simulation page which contains several options such as parts of the eye, the function of the eye, image formation, farsightedness (myopia), and nearsightedness (hypermetropy). Figure 5 is the icon of application which has been uploaded in Google Playstore.
The product evaluation stage resulted in four types of data: (1) data of expert assessment results (materials, media, and teachers), (2) data of phase I limited trial results, (3) data of phase II limited trial results, and (4) data of field trial results. The assessment of qualitative statements from material experts, media experts, teachers, and students was then converted into a five-value scale, and the conversion results are in Table 1.

| Interval | Category   |
|----------|------------|
| X> 4,2   | excellent  |
| 3,5 <X≤ 4,2 | very good |
| 2,6 <X≤ 3,5 | good      |
| 1,8 <X≤ 2,6 | fair      |
| X≤ 1,8   | poor       |

The feasibility test results by the experts are displayed in Table 2; meanwhile, the practicality test results by media experts and teachers on the developed product is seen in Table 3.

| Criterion              | Validator   | Score | Category |
|------------------------|-------------|-------|----------|
| Content feasibility    | media experts | 4,56  | excellent |
|                        | teachers    | 4,64  | excellent |
| Presentation feasibility | media experts | 4,58  | excellent |
|                        | teachers    | 4,60  | excellent |
| Average                |             | 4,60  | excellent |

| Criterion              | Validator   | Score | Category |
|------------------------|-------------|-------|----------|
| Quality and reliability | media experts | 4,34  | excellent |
|                        | teachers    | 4,36  | excellent |
| Ease of use            | media experts | 4,44  | excellent |
|                        | teachers    | 4,50  | excellent |
| Design/layout          | media experts | 4,68  | excellent |
|                        | teachers    | 4,76  | excellent |
| Influence on individuals | media experts | 4,48  | excellent |
|                        | teachers    | 4,54  | excellent |
| Average                |             | 4,51  | excellent |

Based on table 2 and 3 above, the developed product was said to be feasible and practical. The average score of the feasibility test results was 4.60 and categorized as “excellent.” The average score of the practicality test results was 4.51 and categorized as “excellent.”
The product effectivity was measured using the N-gain factor in mastering human eye concepts, and the observation revealed positive activities done by the students during the learning process. The data of concept mastery is presented in Table 4.

| Concept Mastery | Score | Category |
|-----------------|-------|----------|
| Pre             | 54    | fair     |
| Post            | 89    | good     |
| N-Gain Factor   | 0.76  | high     |

The above Table 4 informs that the average score of the students’ concept mastery of human eyes before using the developed product was 54 and belonged to the “fair” category. However, after employing the android-based learning materials, the average score increased by 89 and categorized as “good”. The N-gain was 0.76 and in the “high” category. The data were then converted into numbers, processed, and searched for average values and percentages. The average percentages of the students’ learning activities are presented in Table 5.

| Activity                                                                 | Average (%) | Category    |
|--------------------------------------------------------------------------|-------------|-------------|
| Paying attention to the teacher’s explanation of the procedure for       | 90.4        | very good   |
| operating android-based learning media                                  |             |             |
| Showing enthusiasm in reading the learning materials of human eyes      | 89.5        | very good   |
| on the Android application                                              |             |             |
| Doing the exercises on the Android application                          | 86.0        | good        |
| Doing the evaluations on the Android application                        | 88.4        | very good   |
| Performing simulations and joining quizzes on the Android application    | 90.2        | very good   |
| Discovering ideas, opinions, and statements during the learning process | 92.2        | very good   |
| Teamwork                                                                | 84.8        | good        |
| Participating actively during the learning process                       | 88.4        | very good   |
| Showing enthusiasm and happiness to communicate the results of          | 91.3        | very good   |
| independent learning when using Android-based learning media, the       |             |             |
| subject of the human eye at home                                        |             |             |
| Average                                                                  | 89.02       | very good   |

The average results of the all observed learning activities as informed in Table 5 indicates a “very good” score of 89.02%. Based on the “high” n-gain shown in Table 4 and the “very good” category for student learning activities; therefore, the development of Android-based learning materials on human eyes was declared effective.

The characteristics that are the hallmarks of this product when compared to other similar products are: (1) providing menus: learning objectives, materials, simulations, exercises, and evaluations; (2) each menu has sub-menus such as eye parts, viewing process, and eye disorders; (3) having five interactive and communicative simulation submenus; (4) materials are described attractively through the use of full-color text and images; (5) the teacher can use it as a learning device since it has covered learning objectives, materials, quizzes, exercises, and evaluations with assessment; (6) the application
could be referred to as an independent and repeatable learning source; and (7) usable at anywhere and anytime. On the other hand, the disadvantages of this Android-based learning media are: (1) it has not been able to display 3D objects; (2) for smartphones, it can only be run on the Android operating system; and (3) there is no user track record so that the teacher does not know what pages the user has opened and how the opened-page order.

4. Conclusion
This developmental research has succeeded in developing a feasible, practical, and effective Android-based learning media on human eyes topic. The product eligibility was categorized as “excellent” with a score of 4.60 and the product practicality was in the “excellent” category with a score of 4.51. The product effectiveness was “high” with an n-gain score of 0.76 while the average value of all observed activities was 89.02% and categorized as “very good”.

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