Development of m-learning vertebrate determination program to improve student’ classification and reasoning skills

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Abstract. This study aim to development of M-Learning Vertebrata determination program as media for learning to improve students classification skill and inductive-deductive of reasoning skill. This study used 4-D (define, design, development, and deployment) development method. Results generally show that M-learning Vertebrata determination program for learning have a synergetic effect resulting in enhanced learning. The research findings imply that using mobile learning for study Vertebrate classification had a statistically significant effect on pre-test and post-test achievement scores for increase students classification and reasoning skills. User give the positive response, it means student can operate and simulate M-learning Vertebrate determination program. Based on validation result from validator expert and trial results, M-Learning Vertebrata determination program has legibility to be used as learning media.

1. Introduction
Mobile technologies can be regarded as the most widely used information and communication technologies of today’s world [1]. Mobile devices are becoming increasingly popular and connected with our daily lives [2]. Recent research shows that the usage of mobile devices is gradually increasing [3]. An increasing number of mobile devices, such as tablets and smartphones, have become part of classroom practice [4]. Each new version of these devices brings innovative features that make them more convenient and affordable and new apps continually become available that make our lives easier [2]. Mobile learning emerges due to person-to-person communication done via mobile devices [5]. Utilization of smart mobile software has grown rapidly and become issue in the field of education [6]. Mobile learning or M-learning is a new concept of learning via mobile technology [7]. M-learning can offer important learning potential for high school students keen on using cellular phone-based mobile devices [1]. Learning with mobile devices is highly contextualized and experiential within specific domains [8]. Mobile devices can support flexible learning in a variety of educational contexts [8]. There is great potential in using mobile learning to transform how we learn by changing the traditional classroom to one that is more interactive and engaging [2]. Mobile-learning (M-learning) has transformed the traditional learning context from classroom to a virtual space [9]. M-Learning built functions that exist in the application are assumed to increase students’ achievement for study natural science [9].

As science continues to be fundamental to modern society, there is a growing need to educate on the process of science along with science content. That is, within science courses there is greater emphasis
on the general reasoning skills [10]. Science combines two of philosophical views as the origin of knowledge, in the process of science people will gain knowledge by using their mind (thinking), reasoning and logic. Science requires a reasoning process that leads to developing hypotheses, generating data to test hypotheses, and evaluating & coordinating evidence to draw conclusions; the process occurs gradually. Reasoning is the process of thinking by linking known evidence or facts to get a conclusion. The ability of scientific reasoning is determined as an important factor to encourage student performance in science learning [11]. Science is fundamental for biology learning.

Biological systematics is considered an integral part of the biology curriculum in schools [12]. One of the main goals of biological systematics is to construct a general reference system or classification [13]. Classification is the process of organizing objects into groups based on observed properties so that the pattern becomes clear [14]. Classification skill is the ability to classify based on observable properties, give names and classify a series of objects according to their appearance, size or other characteristics [14]. The ability to correctly identify a particular animal to species is the foundation of biological systematics [9]. Identification key is very important in animal classification study. Identification keys are multidimensional scientific disciplines that describe characteristic, name, classify, and define relationships between species. Identification keys involve taxon measurements or inequality similarities taxon [15]. The present study aims to: (1) Developed of M-Learning Vertebrate determination program (2) Analyze student's classification and reasoning skills after using M-Learning Vertebrate determination program, (3) Analyze user response to M-Learning Vertebrate determination program. M-Learning Vertebrate determination program as an interactive media learning is expected can develop students' classification skill and students' inductive-deductive reasoning skill.

2. Method
This study used 4-D (define, design, development, and deployment) development method [16]. The participants were 108 high school students in SMA Pasundan 2 Bandung. Based on preliminary studies as much as 99% students using android smartphone. Participants were selected based on previously obtained information, to provide data research [17]. Procedure of this research consists of 6 steps: (1) Analysis of problem and material potential, (2) Data Collection, (3) Design, (4) Program developed, (5) Implementation and (6) Evaluation.

3. Result and discussion
3.1. Development of m-learning vertebrate determination program
To developed M-Learning Vertebrate determination is consists of 6 steps: (1) Analysis of problem and material potential (KD analysis, indicator analysis, & material analysis), (2) Data Collection, (3) Design (making flowchart and storyboard), (4) Program developed (making process of M-learning vertebrate determination program by Macromedia flash, Validation, Trials, and Revision of M-learning vertebrate determination program), (5) Implementation (using M-Learning Vertebrate determination program) and (6) Evaluation (user feedback & response to improvement program). Designing games for specific educational purposes presents an interdisciplinary challenge as it requires a deep understanding of game design theory, knowledge of the academic topic, and a foundation in relevant learning theories [18].

Figure 1 show that M-Learning Vertebrate determination program has a main menu consisting of 5 sections: start menu, structure menu, test menu, glossary and menu about. M-Learning Vertebrate determination program contains pictures of the characteristics in question, in addition to the textual description. There are 20 images of vertebrate animals that can be selected for identification animals can be randomly selected if user choose a random button (Figure 2).
The identification process in M-Learning Vertebrata determination program is hierarchical and makes use of dichotomous keys. Students have to choose between two possibilities before moving to the next identification question (Figure 3). To find the right animal among the 20 animal, a student has to go through 12 questions, which involving morphology and anatomy characteristics before ultimately finding the right animal and determination key (Figure 4).

Figure 5 show that structure menu which can be used to learn about the characteristics of vertebrate structure before identifying vertebrate animals on the start menu. The structure's menu consists of morphological and anatomical structures. to study the morphological and anatomical structures in selected animals can be overcome by selecting the numbers in the animal image (Figure 6).
The glossary menu works like a dictionary that contains difficult terms on the M-Learning determination Vertebrate program (figure 7). Figure 8 show that exercise menu to practice questions about the animal characteristics that exist in the vertebrate identification key. The score will appear after completion of the exercise question.

3.2. Students’ classification and reasoning skill

The results showed that the M-Learning vertebrate determination program could improve Students’ classification and reasoning skill. Improvement of students' classification and reasoning skill showed by pretest-posttest result after using M-Learning vertebrate determination program. The mean of pretest score on students' classification skill is 44.32 and the posttest score mean is 73.20 (Table 1). N-Gain for students' classification skill is 0.51 indicates medium category. The students' reasoning skill results pretest score is 44.31 and posttest score mean is 74.64 (Table 1). N-Gain for students' reasoning skill is 0.54 indicates medium category. Studies investigating the effect of technology have previously found support for this reasoning [9]. Mobile learning study had a statistically significant effect on pre-test/post-test achievement scores compared to traditional methods [9].

| Result                  | Mean Pretest | Mean Posttest | N-Gain | Category |
|-------------------------|--------------|---------------|--------|----------|
| Classification skill    | 44.32        | 73.20         | 0.51   | Medium   |
| Reasoning skill         | 44.31        | 74.64         | 0.54   | Medium   |

3.3. User response

The results of user responses show positive response for M-Learning Vertebrate determination program as a learning media show in table 2. Data analysis of user questionnaire in table 2 shows M-Learning Vertebrate determination program is interesting learning media percentage is 93.05 %. Learning using M-Learning Vertebrate determination program provides benefits show percentage 98.60 %. Program is easy to use because it can be indicated by a percentage 15.25 % for difficult to used program. That is related to the question, the steps of identifying in M-Learning Vertebrate determination program is easy to understand show percentage 91.65 %. Technology supports learning, over and above traditional methods. Further, students may be interested in, and motivated for, technology, thus M-learning for learning have a synergetic effect resulting in enhanced learning [9]. Programs have many advantages that can improve students' classification and reasoning skills. The negative effects and limitations of using mobile devices in educational settings is the limited screen size of mobile phones, the adaptive presentation of learning materials has also become an issue that needs to be explored [8].
Table 2. Data analysis of user questionnaire.

| Questions                                                                 | Response (Yes) |
|--------------------------------------------------------------------------|---------------|
| 1. M-Learning Vertebrate determination program is interesting learning media? | 93.05 %       |
| 2. Did you enjoy to used M-Learning Vertebrate determination program?     | 97.20 %       |
| 3. M-Learning Vertebrate determination program can help you to learning about vertebrate classification? | 95.85 %       |
| 4. Learning using M-Learning Vertebrate determination program provides benefits? | 98.60 %       |
| 5. M-Learning Vertebrate determination program can increase classification skill? | 91.65 %       |
| 6. Learning by using M-Learning Vertebrate determination program helps to make deductive conclusions? | 91.65 %       |
| 7. Learning by using M-Learning Vertebrate determination program helps to make inductive conclusions? | 93.05 %       |
| 8. Using M-Learning Vertebrate determination program is difficult?         | 15.25 %       |
| 9. The steps of identifying in M-Learning Vertebrate determination program is easy to understand? | 91.65 %       |
| 10. Images, animations and designs of M-Learning vertebrate determination program is interesting? | 86.10 %       |

4. Conclusion
There are 6 steps to developed M-Learning Vertebrate determination consists of (1) Analysis of problem and material potential (KD analysis, indicator analysis, & material analysis), (2) Data Collection, (3) Design (making flowchart and storyboard), (4) Program developed (making process of M-learning vertebrate determination program by Macromedia flash, Validation, Trials, and Revision of M-learning vertebrate determination program), (5) Implementation (using M-Learning Vertebrate determination program) and (6) Evaluation (user feedback & response to improvement program). M-Learning vertebrate determination program can improve Students’ classification and reasoning skill. Improvement of students' classification and reasoning skill showed by pretest-posttest result after using M-Learning vertebrate determination program. The results of user responses show positive response for M-Learning Vertebrate determination program as a learning media.

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