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Effect of STEM mobile learning package on ecosystem upon students' science and technology literacy

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Abstract. This study aimed to identify the effect of the STEM Mobile Learning Package on Ecosystem upon students' science and technology literacies. STEM Mobile Learning Packagedeveloped with R&D design was validated as a teaching model with good criteria' by both the media and biology content experts.Based on the student assessment, the legibility aspect of this STEM mobile learning package was also classified as very good. The implementation of this learning package was then assessed by the biology and natural Science students from the Unnes faculty of mathematics, and sciencesstudents (FMIPA) as research participants. Data were analyzed descriptively by both qualitative and quantitativemethods. The findings showed that STEM Mobile Learning Package on Ecosystem was effective in terms of the student science literacy, ranged from 64.6 to 98.6. The highest achievement of student technology literacy was 92 with an average score of 70.32. In sum, the STEM Mobile Learning Package on Ecosystem was effective in developing students' science and technology literacy. It is suggested that some learning packages be studied independently, other certain topics be directly presented by *off-line* orface-to-face discussion.

1. Introduction

The 2013 national curriculum in Indonesia has been seen as the new competency-based curriculum with the limited quality implementation. This curriculum has not been wellimplemented to inculcate character education and students are not prepared for global and future competition. It, therefore, needs other teaching approaches that can be used to support student competency for facing the changing world. One of the promising teaching approachescalled STEM, derived from Science, Technology, Engineering, and Mathematics has been the focus of educational reform in United States and has been popularacross the world [1,2].This is an integrated teaching approacheswhich provide students with emphasis on integration of science, technology, engineering, mathematics,and problem-based learning. The fundamental goal of this approach is to create a leader for future that can bring a positive change on the community.

Torlakson underlined that the integration of the 4 aspects of learning is necessary since students are provided with the real problems and problem-based teaching [3]. This approach was considered as a new of model of teaching that can create a cohesiveand active teaching system. Students are also able to integrate the four dimensions. A challenge for science educators is to create a educational system that can provide students with connectingskills of knowledge and skills. Pfeiffer, Ignatov, and Poelmans mentioned that under STEM teaching system students use knowledge and skills integrated[4]. Students can link every dimension of STEM and this is a good indicator that students

can metacognitively integrate all aspects of teaching, such as (1) science as knowledge about facts, concepts, rules, laws, that should be understood, (2) technology as a skill used for managing community, organizedation, knowledge, and critical tools for easying jobs, (3) engineering as knowledge about operationalisation or design of procedure for solving problems, (4) mathematics as knowledge about integration of numbers, rooms with logical reasoning without empirical evidences. All these knowledge will be meaningful when integrated.

Teaching science with STEM approaches directly provide students with direct practice in integrating all aspects of learning. This integration makes students easily learn them. Bybeebelieved that this approach encouraged students to easilyunderstand knowledge of concepts in authentic problems [5]. In physical science teaching, students use technology to conduct an scientific experiment to prove scientific law or concepts. All findings are then supported by datamanagement supported by mathematical reasoning.

Mobile learning package as defined by Quinnis a model of teaching using Information Communication Technology [6]. Learning materials with beautiful visualizationcan be accessed by students every time. This kind of teaching model help students cope with learning time and distance problems. All teachology tools are involved, namely computers, MP3 player, notebooks, mobile telephone and tablets. Focus of this mobile learning are on students with their interaction with portable technology.

The biology topics, ecosystems, require students to use natural environment as the authentic learning resources. The use of natural environments usually take expensive cost and time. However, this learning package can overcome this limitations, and students can maximize the use of learning package every time that they are in need.Based on this reasoning, this study was aimed to identify the effectiveness of the use of STEM mobile learning package on ecosystemin providing students with basic concepts of ecosystem, environmental and scientific literacies.

2. Methods

This research has been conducted at Jurusan Biologi FMIPA Unnes Semarang from January-December 2018. Preliminary information (data) of developingmobile learning package was collected and shared with Thai researchers with similarinterest, conservationist, Kasetsart University, Bankok Thailand. First step of the study was focused on the development of valid and reliable the learning package assessed by the media and biology content experts. Then, its practicability was validated by Unnes students. Field testing was then implemented by the use of EDMODO that can be online accessed by biology students undertaking a course subject Ecology.Second step was then focused on experimental design. A group of biologystudents takingecology with both theory and practicum were treated as experimental groups. Another group of natural science student, taking similar subject (only ecology without practicum) was treated as the control one, never introduced with ecology tools. Thisdifferent treatment was used to identify the effect of STEM model of teaching upon students' science and technological literacies. One shoot case design of research was used and parametric t-test was implemented.

3. Result And Discussion

3.1. Findings

The STEM mobile learning package on ecosystem (STEM-MLP) integrated in EDMODO was successfully uploaded. This package consists (1) introduction, goal,and steps of learning is presented, (2) learning materials of ecology, narratedvideo of ecosystem in Wana Wisata Semarang, observation tools, as well as demonstration video on how to use these tools, and (3) evaluation tools such as tests and questionnaires. This application can be downloaded via sringabekti.stem@gmail.com. password biologiunnes.

This EDMODO application was then uploaded 5 days before ecology examination tests. Keeping contact with students was implemented via WhatsApp (WA) to make sure that every students of ecology have access to EDMODO. Students were invited to read all the materials presented, from

introduction, learning materials, supplemented audio and visual media, and examination test materials. Finally, students were also to fulfillquestionnaires of readability and practicability. Time restriction was implemented to motivate students in learning.

The effectiveness of this teaching model will be more significantly clear after this model is tested under large scale field testing. However, this field testing is not yet completed because the academic year 2017/2018 is not yet finished. Under the limited field testing, the temporary findings showed that (1) minimum score of science literacy was 48,9, and the highest one was 98.8; the average score was 72.18. Sum of questions to be addressed was 60 items, and the question number 51 -60 was the one relating to mathematics calculation (2) minimum score of technology literacy was 38 and the highest one was 88, its average score 70.32. All these score were collected after students completed the tests of the use of ecology tools, including steps of using that technology, (3) the average score for both literacies was 43.2 to 87.2 (61.25) with the similar criteria.Among 50 students involved in this research were (1) 34 students were ones from biology education department and another 16 was from integrated science department. The big difference between the low and the highest score was caused by the difference in Semester Unit System (SKS) between biology education department.

The next screening was focused on the average score of practicum and problem exercises among 40 biology education department and natural science department students. Finding showed that due to the Mann Whitney test, there was no difference between average scores (scienceliteracy) among those students, but there was a difference score of technology literacy among them (asymp.sig. 0,00 < 0,05).

3.2. Discussion

What can be learned from these findings? First, the final product of the blended learning was validated by 3 different parties, students and one media experts and biology content expert. In Indonesia the use of internet for learning has been increasing. This is the reason of why the mobile learning package was officially welcomed by students. The number of students using computers (laptop, notebooks) at Unnes campus has been increasing significantly during the last 5 years. In terms of ecology content, all validators had approved the quality of learning material presented because of the familiarity of the content. Ecology is the major topic   that many university teacher are familiar with.Second, though the process of study is not completed yet, but there is a tendencythat the nature of STEM teaching approach affect students' learning achievement.

Many research findings has also underlined the similar results. Eskin mentioned that this approach improve students' knowledge and skills in developing career [7]. STEM seems to be able to provide students with integrated knowledge and understanding of authenticproblems through both hands- and minds-on activities. The use of IT can satisfy the needs of Net generation[8]. Third, change is not a simple business, it is related to other multi-factorsresponsible forit. The implementation of this approach depends on other supporting factors, both internal and external ones [9]. The implementation of STEM education is correlated with teachers' understanding of this approach itself. STEM education in school was also colored by teachers' attitude to this approach and it school context. Thibaut, et.al. and Dai and Cromley suggested that changes in students' belief and gatewaycourse achievement be continuously monitored to make sure that this approach promotes students' understanding and learning achievements [10,11]. Finally, this model of this approach integrated in ecosystemteaching-learning could be expected to be one of the integrated science teaching at Unnes campus. Many research findingssupports the implementation of STEM in schools. Similar results showed that students participating in STEM programs experienced a better knowledge or skills of understanding of science and technology. As examined by Hu and Hibel students involved in STEM education in China would be accepted by labor market and awarded with better financial earnings [12].

4. Conclusion

The STEM mobile learning package on ecosystem(STEM-MLP) using EDMODO has been finally validated by the media and biology experts, and its practicability was verified by both science and biology students. This packagecontains introduction, goal and learning steps, learning materials,

narrated video of Wana Wisata Semarang, observation tools, demonstration video on how to use technology tools, and set of assessment tools such as tests and questionnaires. This application can be downloaded via sringabekti.stem@gmail.com. password biologiunnes. The implementation of this learning model has brought a significant effect upon the quality of student learning achievement, both technology and science literacies.

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