

## Conference Paper

# Legibility Level of STEM Mobile Learning Package on Ecosystem

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## Abstract

STEM in education has been discussed as an approach that enhances students to demonstrate their holistic knowledge in some projects given. Teacher could support STEM in learning process by providing students proper learning material such as learning environment, learning resources, and medias. This research aimed to test legibility level of texts uploaded on STEM Mobile Learning Package (STEM MLP) on ecosystem as one of students' learning resources. Legibility level data was obtained from questionnaire from small scale test on 47 students. Data were analyzed descriptively by both qualitative and quantitative methods. The finding showed that legibility level from students' questionnaire ranged from 78,7 percent to 97 percent. In addition, Fry Graph analysis showed that texts in STEM MLP were in area 13<sup>th</sup>. It means texts were consider understandable to read by undergraduated student. Thus, most of students could understand ecosystem content in STEM Mobile Learning Package very well. They also stated they could learn the material independently by using the package but they still needed direct learning for deep understanding of ecosystem. It is suggested that STEM mobile learning package on ecosystem has had a high legibility level.

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## 1. Introduction

Ecosystems at the global and national levels of Indonesia are decreasing in quantity and quality. People activities in maintaining biodiversity and habitat are still not sustainable. The decline in biodiversity continues to occur because not all communities have an awareness of the importance of wise ecosystem management.

Management of biodiversity and its ecosystems as covered by Law Number 5 of 1990, is not solely the duty of the government, but also a shared responsibility with all levels of society. By realizing that human is part of ecosystem component, people should always consider environmental factors in every activity and development.

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Efforts to foster public awareness in managing the environment can be implemented through education, both formal and non-formal education. Formal education in Indonesia ranging from primary, secondary, to higher education. At the environmental conference in Stockholm, the 10th principle states that environmental education for both young people and adults is essential to broadening knowledge, insight and behavior responsibility from individuals, companies, and society in protecting and improving the environment (UNESCO-UNEP, 1983).

Education plays a role as a shaper and spreader of the values needed to deal with environmental demands. Environmental education is one of the long-term strategies to prevent environmental damage, conserve biodiversity, and ensure sustainable development. Environmental education must be carried out continuously from childhood to old age in the family, school, and in the community with an adequate curriculum.

The education curriculum in Indonesia is currently considered not able to form characters to be ready to face global competition. For this reason, an education approach based on science, technology, engineering and mathematic (STEM) is needed. STEM emphasizes interdiscipline approach and its application in active problem-based learning.

The aim of STEM is to prepare students to be competitive and ready to work according to their educational background [1]. Research conducted by the Hannover research institute stated that the main purpose of STEM Education is an effort to demonstrate holistic knowledge among STEM subjects. Integration in STEM learning is considered successful if all aspects of STEM are found in each learning process for each subject [2].

Advance technology and information can be used for learning, such as mobile learning (m-learning). M-learning according to Clark Quinn (2000) is a learning model that utilizes information and communication technology [3]. M-learning brings the benefits such as the availability of learning materials that can be accessed any time and interesting visualization of learning material. This model can overcome distance and time on learning by using mobile educational technology tools. This study aims to develop STEM Mobile Learning Package (STEM MLP) on ecosystem. This learning package is important to equip students to understand the basic concepts of ecosystems, so that students have scientific literacy and technology to preserve the environment.

## 2. Method

This research has been conducted in Biology Department, FMIPA UNNES Semarang from January to December 2018. This study implemented Research and Development (R & D) as a research method used to develop certain products. The developed product in this study is STEM MLP on ecosystem. It has been uploaded in the EDMODO application. The development products can be monitored by e-mail sringabekti.STEM@gmail.com with password: biologiunnes. Ecosystem learning packages have been validated by content and learning media validators that showed very good results. After undergo some revisions, it was then tested to measure its legibility level.

Anih and Nurhasanah summarized several methods to measure the level of legibility [4]. These methods include subjective assessments, question and answer, Cloz techniques, reader responses, and legibility formula. The legibility level in this study was analyzed using reader responses and legibility formulas

The form of the questionnaire statement is a semi-closed statement filled online by students. Data from student response questionnaires were then measured using a rating scale. Questionnaires were analyzed using the following formula and criteria.

$$P = \frac{f}{n} \times 100\%$$

Information:

P: percentage legibility

f: student answer score

n: Maximum total score

Legibility formula follows the Fry Graph formula that has been adapted to Indonesian language rules by Harjasujana and Mulyati [4, 5]. The application of the Fry chart formula are describe below.

1. Choose a sample of 100 words from a fragment of representative reading text. If the book or module is very thick, it is recommended to take samples from the beginning, middle and ending parts.
2. Calculates the number of sentences that make up 100 words to the closest tithe. For example, there are 12 sentences that compose 100 words. The 12<sup>th</sup> sentence contains 16 words. The 100<sup>th</sup> word falls on the 8<sup>th</sup> word of the 12<sup>th</sup> sentence. The sentence is calculated as 8/16 which is 0.5 so the total number of sentences is 11.5.

3. Calculate the number of syllables until the 100<sup>th</sup> word then multiplied by a factor of 0.6. For example, total number of syllables is 217 multiplied by 0.6 is 130.2. A value of 130.2 is rounded to 130 syllables.
4. Draw the value of the number of sentences and the number of syllables obtained into the Fry Graph. The perpendicular line shows the number of syllables per hundred words and the horizontal line shows the number of sentences per hundred words. The meeting point of the two values shows the grade level that corresponds to the reading text studied.
5. Deviations can occur from the results of the plot obtained. Therefore, the grade level obtained should also be increased and reduced by one level. If the result of the plot shows level 5 then the class level that is suitable for the reading text measured is level 4.5, and 6.

### 3. Result and Discussion

The legibility level of a book or module is an element that needs attention. Fadilah stated that the legibility level influences the level of readers' understanding [5]. The higher the legibility level, the higher the reader's understanding of a module's content. Jatnika explained that there are 2 general factors that influence the legibility level namely language and display factors [6]. Language factors include word selection, sentence structure, paragraph arrangement, and other language elements. Display factors are typography such as type and size of letters, line density, width and other display elements [6]. In ecology courses, especially in ecosystem subject, students use STEM MLP in the learning process. The legibility level of the MLP STEM is measured using students' legibility questionnaires and Fry chart data.

STEM MLP on ecosystem was visited by 164 out of 180 (91 percent) students who have been taking Ecology class. By randomly downloading the legibility questionnaire at EDMODO, data collected from 47 students who have completely filled 12 statements in questionnaire. Figure 2 shows the number of students participated in using STEM MLP.

About 78,7 percent students stated they could understand the questions very well. Most of students (97,8 percent) agreed that the use of STEM MLP enhanced their science literacy. Percentage of students that agreed on 12 statements ranged from 74,5 to 100 percent. There are two statements, number 6 and 11, that all of students agree with.

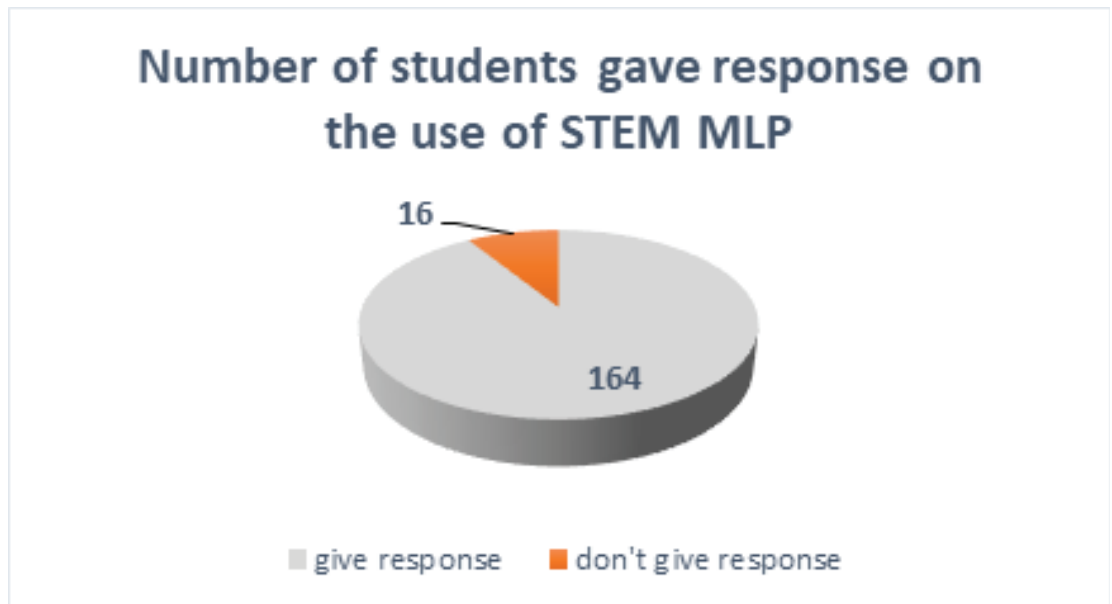


Figure 1: Number of students participated in using STEM MLP.

Thus those result indicated a high level of legibility. The completed percentage value of 12 statements is showed on Figure 2.

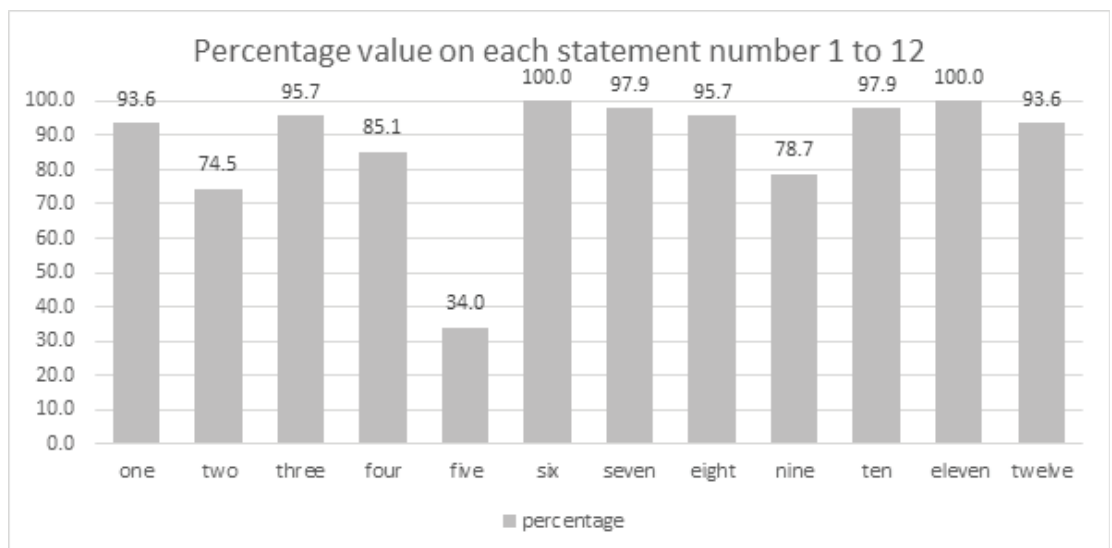


Figure 2: Percentage value of statement number 1 to 12.

As for the 3 statements that most of them answered 'no', the students gave reasons such as the following.

1. Statement number 2 "STEM MLP on Ecosystem is communicative so that it is easy to learn" is answered no, because most of students claimed MLP is efficient in time but in certain subjects it cannot be studied independently.

2. On statement number 5 “STEM MLP on Ecosystem has a clear voice” most of students answered ‘no’ with no reason or wrote they listened the less clear voice. However, this problem could be overcome by the existence of subtitle matches the voice given.
3. Many students disagreed with statement number 9 “STEM MLP on Ecosystems is easy to understand” with no reason or confirmed they often found some sentences are difficult to understand

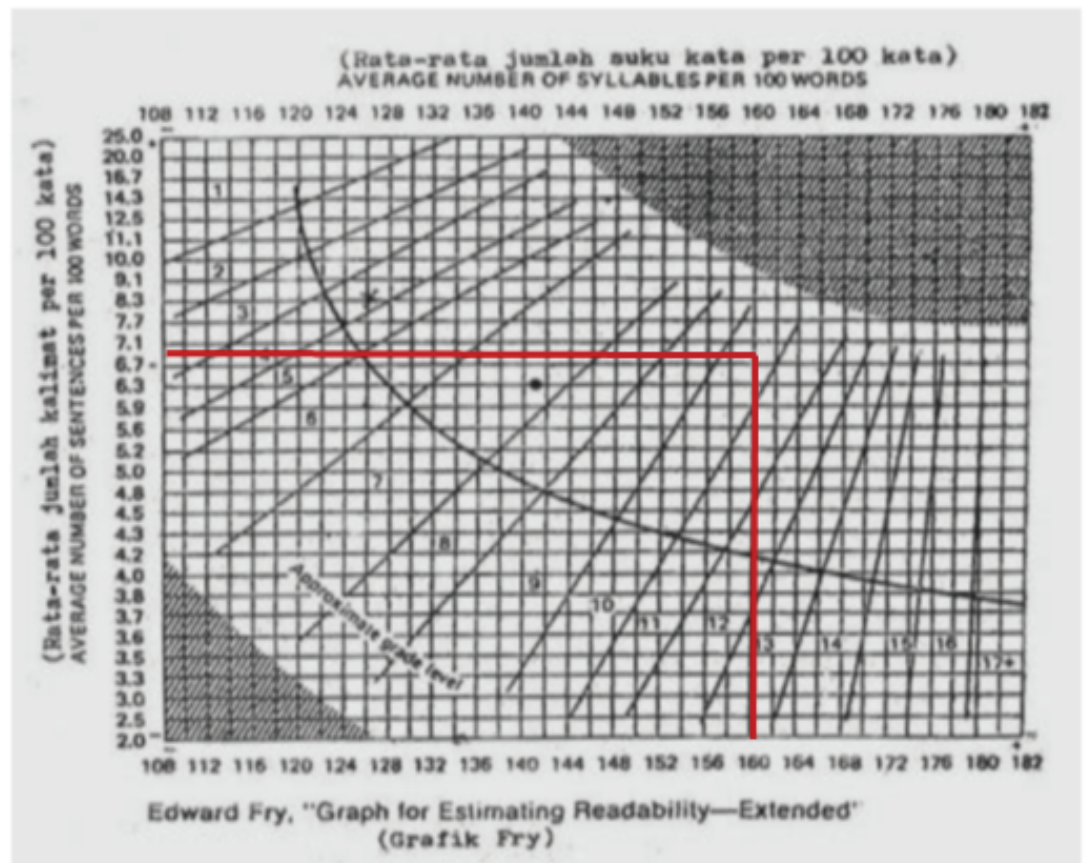
Legibility level is also measured using the Fry chart. There are 4 reading texts in the MLP STEM to be analyzed: 1) Article “Introduction to STEM in EDMODO”; 2) Handbook “Ecology with JAS approach”, chapter ecosystem; 3) Article “Ecosystem problem in Wanawisata Semarang, Semarang district”; and 4) Surber net and Eckman Grab SOP. Calculation of number of sentences and number of syllables from four samples of the reading texts are summarized in Table 1.

TABLE 1: Calculation of number of sentences and number of syllables.

Numb	STEM MLP Content	Part	Words	Number of Sentences	Number of Syllables (*0,6)
1	Article “Introduction to STEM in EDMODO”	1 paragraph	100	6,11	172,2
2	Handbook “Ecology with JAS approach”, chapter ecosystem	beginning	100	6,54	157,2
		middle	100	3,38	153,6
		ending	100	6,31	156,6
3	Article “Ecosystem problem in Wanawisata Semarang, Semarang district”	1 paragraph	100	7,38	162
4	Surber net and Eckman Grab SOP	1 paragraph	100	5,55	139,2
<b>Summary</b>				35,27	801,6
<b>Average</b>				7,054	160,32

The average number of sentences is 7.054 rounded to 7. The average number of syllables is 160.32 rounded to 160. This result was then plotted into the Fry Graph as shown in Figure 3.

On the Fry chart, regions 1 to 17+ show grade levels. If the meeting point is in region 1, the readability level of a text is appropriate for grade 1 students. If the plotting results show intersection is below 12, the text is more appropriate for the level of secondary school students. If the price of the meeting point is above 15, undergraduate students have difficulty to understand content from texts. Figure 4 shows that the intersection



**Figure 3:** Plotting of calculation of number of sentences vs. the number of syllables from reading texts on STP MLP.

of number of sentences and number of syllables is in region 13. It means legibility level of STEM MLP reading text is suitable for grades 12, 13, and 14 which is suitable for undergraduate students. Thus, reading texts uploaded on STEM MPL ecosystem material were understood by undergraduate students very well. The results of the Fry chart analysis also support the results of legibility questionnaire analysis. Otherwise, reading texts of STEM MLP on ecosystem has shown a good level of legibility and is suitable for use by undergraduate students.

What can be learnt from these findings? First, the final product of the blended learning was validated and legibilited by 3 different parties, one media experts and biology content expert and students. 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.



Ecosystem 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 tendency that the nature of STEM teaching approach affect students' learning achievement. Many research findings has also underlined the similar results. STEM approach improve students' knowledge and skills in developing career [7]. STEM seems to be able to provide students with integrated knowledge and understanding of authentic problems through both hands-and mind-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 factors responsible for it. The implementation of STEM depends on other supporting factors, both internal and external ones [9]. The implementation of STEM education is correlated with teachers' understanding of STEM itself. STEM education in school was also colored by teachers' attitude to STEM and its school context [10]. Changes in students' belief and gateway course achievement be continuously monitored to make sure that STEM promotes students' understanding and learning achievements [11] Finally, this model of STEM integrated in ecosystem teaching learning could be expected to be one of the integrated science teaching at Unnes campus. Many research findings on STEM supports 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. Students involved in STEM education in China would be accepted by labor market and awarded with better financial earnings [12]

## 4. Conclusion

The legibility of STEM MLP has been measured by using questionnaire. The answer of each statement then counted using a formula and criteria given. Result showed that percentage value of students that agreed on 12 statements ranged from 74,5% to 100%. The Fry Graph's analysis showed legibility level of STEM MLP's text was in region 13 which means texts are understandable for undergraduate students. Those result indicated STEM MLP on ecosystem has a high legibility level.

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