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Preliminary Descriptive Insights into Student Generated Activities for STEM subjects through Mobile Learning in a Malaysian University Context

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Abstract
There is a lack of interest in learning STEM among students in Malaysia. Hence, this research aims to investigate the benefits of student-generated activities through mobile learning in STEM subjects. The methodology used in this research is quantitative with a descriptive survey using students from Sultan Idris Education University, Malaysia. The results of the findings indicate that through student-generated activities, students show an improvement in learning STEM subjects, by means of a high utilization of their mobile devices for learning. This finding may help to implement mobile learning in the classroom in the future further and help students better understand and learn STEM subjects.
Keywords: Mobile Devices, STEM, Student-generated Activities, Mobile Learning

Introduction
Integrative STEM education is defined as general education with a focus on preparing citizens that can function in a science and technology-rich society. According to Labov, Reid and Yamamoto (2010), and Sanders (2009), STEM is the purposeful integration of all four (4) disciplines – science, technology, engineering, and mathematics – as one unit for solving real-world problems. In this study, STEM could be enhanced by having mobile devices for the students.

Mobile learning has expanded in technology bringing an advanced transformation in reliability and easy access through the use of portable devices. In addition, students can easily adapt to learning that is fun and challenging, for exploration and to satisfy their curiosity, which means a different era that will tackle different techniques of pedagogy. Hence, with the transformation in mobile technology, the technique of teaching should be interesting through the use of mobile devices. For instance, mobile learning facilitates learning through the use of a mobile device, through which learning becomes more motivated as students learn new things each day.

Through mobile learning, the students are encouraged not just to learn what they would in class but also to explore outside the class. Furthermore, the use of mobile learning can be explored for STEM (Crompton & Traxler, 2016). Crompton & Traxler (2016) contended that STEM has fallen behind in progressed in mobile learning, particularly in a developed nation. Additionally, Ariffin (2014, 2017) suggested that mobile learning could be implemented in other subjects including STEM. This constitutes one of the reasons why mobile learning in STEM needs to be researched.

Mobile Learning

Mobile learning or mLearning (e.g., mobile device, mobile phone, or laptop/computer) is a new approach to the educational paradigm where learning is concerned. Mobile learning is the process involving conversations across multiple contexts amongst people using personal interactive technologies (Sharples, Taylor, & Vavoula, 2010). The implementation of STEM in education in Malaysia has really benefitted students in the areas of science, technology, engineering, and mathematics. The focus of STEM is to drive ICT in the economy based on knowledge through innovation and productivity to increase competition and wealth.

According to Sander (2009), integrative STEM education is defined as general education with a focus on preparing citizens that can function in a science and technology-rich society. According to Labov, Reid, and Yanamoto (2010), and Sanders (2009), STEM is the purposeful integration of all four (4) disciplines – science, technology, engineering, and mathematics – as one unit for solving real-world problems. In this study, STEM could be enhanced by mobile devices for students.

Science, Technology, Engineering, and Mathematics (STEM)

The definition of STEM education is learning and teaching in the fields of science, technology, engineering, and mathematics, and includes education from all grade levels from pre-school to post-doctorate in both formal and informal learning (Gonzalez & Kuenzi, 2012). During the 1990s, the National Science Foundation (NSF) used “SMET” as a short term for “science, mathematics, engineering, and technology.” However, as the “SMET” acronym seemed somewhat annoying and sounded like “smut,” “STEM” was introduced (Sanders, 2009).

Student-Generated Activities

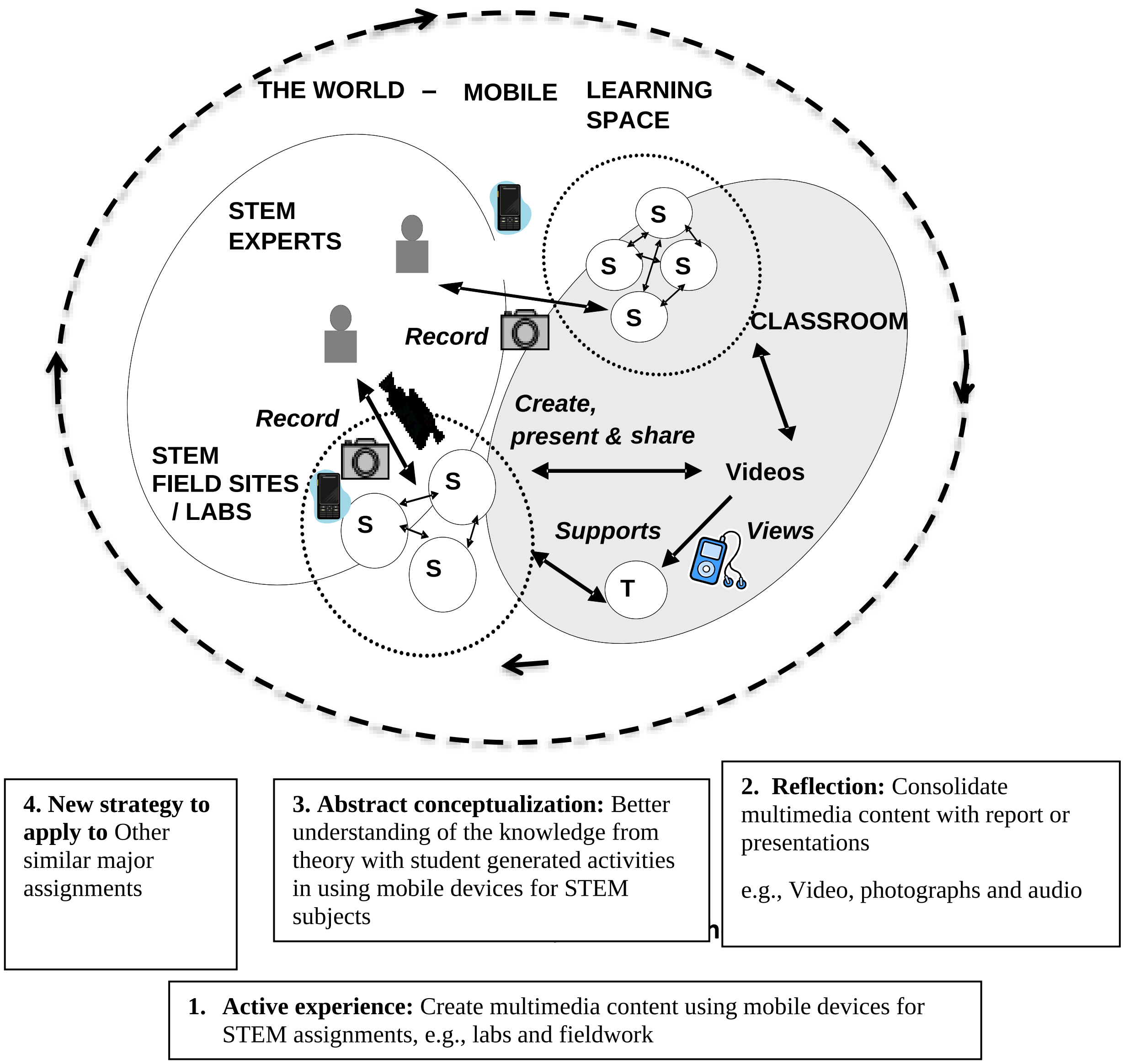

Figure 1. Student-generated activities for STEM adapted from Ariffin (2014)

Student-generated mobile learning activities are among the activities for overcoming the lack of local content in the study of STEM. Hence, this section leads to a discussion on student-generated content, which changes the perspectives of learning STEM, such as with the creation of local content using mobile devices. Figure 1 illustrates the student-generated activities' process for STEM in the Malaysian context, which was inspired by the good pedagogical approach of experiential learning (Dewey 1938; Kolb 1984; Naismith et al. 2004) as adapted for mobile learning from Ariffin (2014), and Dyson et al. (2008). The adapted experiential learning process for student-generated activities for STEM in the Malaysian context for universities consists of active experience, reflection, abstract conceptualization, and a new strategy. These student-generated activities using mobile devices have also been conducted in the classrooms.

After student-generated activities, participants are more aware of the benefits that mobile learning can offer. Students are reported as being very active in terms of collaborating and participating in student-generated activities. They are more aware of the variety of mobile learning types, such as accessing and sharing learning resources, which have been demonstrated in this study. In addition, their teachers are also more aware of other types of mobile learning and are more open to the usage of mobile devices, such as mobile phones in their classroom for student-generated activities. Furthermore, students have a better understanding of STEM subjects from the student-generated activities; they can revise their digital content, and understand the process they captured that relates particularly to their subjects. Consequently, these student-generated skills can be applied to other subjects with similar student-generated activities. In turn, this leads to a better quality of learning that has been introduced by student-generated activities that also answers the challenge to reduce the lack of local content; as highlighted earlier in the literature and stressed by Malaysian Minister Lim (2005), and Minister Rais Yatim from Bernama (2010).

Opportunities in Stem through Student-Generated Multimedia Activities

In experiential learning, students undertake activities instead of sitting passively, which is applicable to student-generated activities that emphasize student-centred learning using mobile devices for their subjects (Ariffin, Dyson & Hoskin-McKenzie, 2012). STEM promotes student interest through new learning system approaches and enhanced curriculum by using mobile devices. However, based on the personal observation of the researcher, Malaysian students, mostly from Sultan Idris Education University, used their mobile phone more for social media than for learning or exploring new technology (Ariffin, 2014). The issue here is the lack of awareness concerning the exploration of mobile learning and the knowledge of the latest technology among students. Thus, mobile learning for student-generated content could be a possible way of attracting students to learn STEM (Ariffin, Dyson & Hoskin-McKenzie, 2012).

Methodology

Descriptive Surveys

For this research study, UPSI, a local education university in Tanjung Malim, Perak, was selected. The respondents, who are degree students from five (5) different courses, are the main focus in this research. A total of 112 students aged 19-25 from five (5) classes – two classes from the same course – answered the questionnaire. They had to answer based on their experience and understanding in using mobile learning for STEM. This is a qualitative research supported by a descriptive survey. In this study, the students used their own mobile devices, such as a mobile phone, for the video project for their STEM subjects. This process was applied to the STEM associated subjects for the mobile learning "blended mode" in the Malaysia context.

Likert Scale

The Likert scale is one of the most widely used scaling responses in survey research. In this research, the scale was adopted for the descriptive statistics while considering the mean from lowest to highest in the likelihood from 1 to 5. When responding to a Likert item, the respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale for a series of statements. Below is the list of questions used based on the Likert Scale. The question themes ask about their agreement with various issues and to identify the likeliness of the issues. As for the calculation of the scale, the assumptions are derived from the data, which are used to calculate the mean for each question. The assumptions are shown in Table 1.

Table 1. Scale assumption for calculation of the mean

Scale	Value (Y)
Never	1
Rarely	2
Sometimes	3
Regularly	4
Always	5

By using the assumption, the mean formula for this research is shown in Figure 2, which is derived from the average formula.

Fig. 2 The formula for the Mean

$$\mu = [P\ (X) * Y\ ]/\mathrm{N}$$

μ = Mean/Average Y = Scale Value N = Total number of students (112)
P = Question X = Issue

Findings

In this study, the participants used their own mobile devices, such as mobile phones, following the student-generated learning interventions. These are the changes that were advised by the researcher and applied in the video developed. Overall, the results show a greater awareness and knowledge about mobile learning in STEM subjects. The students became more adventurous and experimented by doing new things with their mobile devices for assignments. The student-generated content activities increased collaboration around mobile learning. Additionally, students became better at doing their assignments related to STEM. They had a better understanding of their subjects through the learning activities of the student-generated content and demonstrated more interest in learning the subjects. Academics allowed the students to use their own mobile phones for student-generated content activities, such as for video and sound recordings in the classroom, and also during fieldwork. The academics acknowledged that the students' assignments from the student-generated content activities demonstrated an improvement in their students in learning STEM.

Data Analysis and Results of Post Investigation of Mobile Learning Respondents

A total of 112 students answered the survey – males 41 (37%) and females 71 (63%). The students came from the Faculty of Art, Computing and Creative Industry, and the Faculty of Science and Mathematics, University of Education Sultan Idris. This indicates that more female students than male students responded.

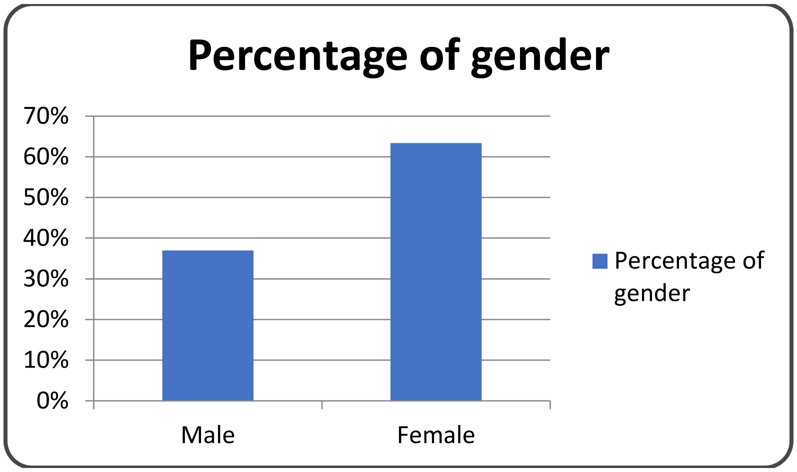

Figure 3. Percentage of gender

Choice of Mobile Devices

As shown in Figure 4, the results indicate that most of the participants owned mobile devices such as mobile phones. They can use the mobile devices functions for personal daily use. In this study, the participants expressed the reasons they own mobile phones and why they use mobile phones for personal daily use.

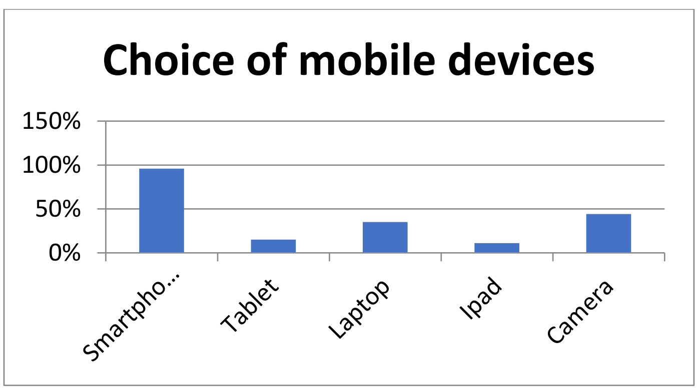

Figure 4. Choice of mobile devices

Mobile Learning after Student-Generated Content

After the student-generated activities, the students think about the mobile learning activity, for sharing information, 110 from 112 (98%) answered yes; for answering quiz, 102 from 112 (91%) answered yes; games and applications 93 (83%); for finding information 108 (96%), for multimedia recording during class 88 (79%); and multimedia recording outside class 95 (85%).

Additionally, this indicates that students have the highest understanding in respect of the mobile learning definition for a. Sharing information (98%), b. To find information (96%), c. For answering quiz (91%), d. Multimedia recording outside class (85%), e. For games and application (83%), and f. Multimedia recording inside class (79%).

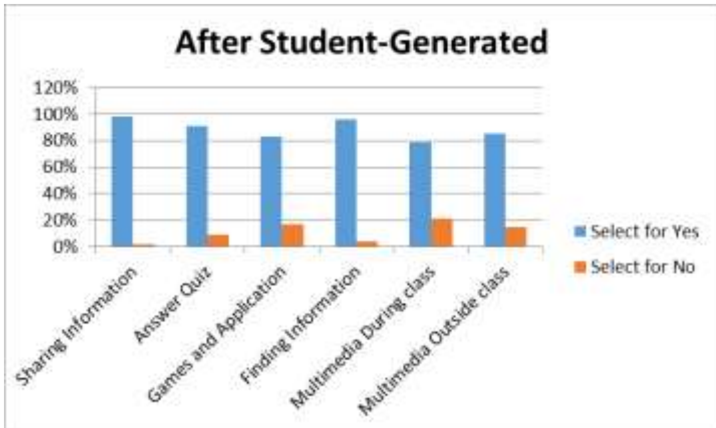

Figure 5. Mobile learning after student-generated activities

Stem Learning

The study found that the respondents were more familiar with STEM after student-generated activities. The questions asked the respondents how they learn STEM and mobile learning. As shown in Figure 6, the results show that 71.4% of the respondents self-learned about STEM using mobile devices. In addition, during the study, 80 (71.4%) students self-learned, 70 (62.5%) from friends, 22 (19.6%) from family, 36 (32.1%) from teachers, and 19 (17%) answered from others. This indicates that self-learned is the most important practice for learning STEM using mobile devices.

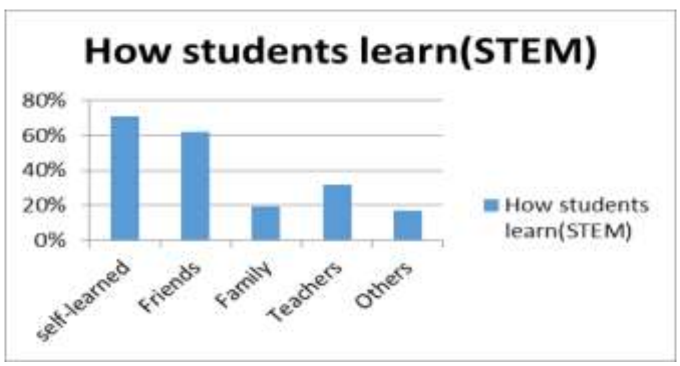

Figure 6. How students learn STEM

Student-Generated Activities for Improving Stem Learning

The students indicated that the student-generated activities for STEM had improved their learning and understanding, those who said they have good improvement are 74 (66.1%), excellent improvement for 15 (13.4%), average improvement for 79.5 % a bit of improvement with 22 (19.6%), and with an exception for none improvement for 1 (0.9%).

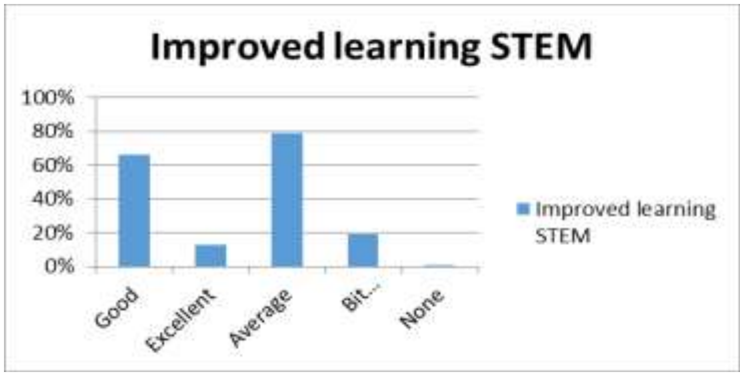

Figure 7. Students learning improved STEM learning

Student-Generated Activities Achieved Via Collaboration
A total of 31 (27.7%) students answered that they always worked with friends for accomplishing STEM assignments; 29 (25.9%) answered regularly, sometimes for 50 (44.6%), and 2 students (1.8%) answered never. This indicates that students work collaboratively for STEM student-generated activities.

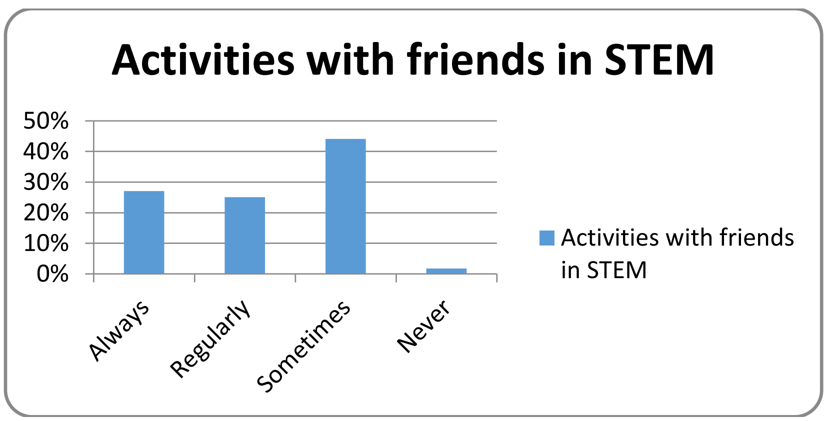

Figure 8. Students generated activities achieved via collaboration with friends

The statistics below show the mean for mobile phone use for completing assignments: For record audio the mean is 3.53, record video has a mean of 3.58, take photo has a mean of 4.14, edit video has mean of 3.17, edit audio has a mean of 2.92, and edit photo has a mean of 3.45.

Table 2. Mobile phone used for completing assignments

Which did you use your mobile phone for in completing your assignment?						
Criteria	**None (1)**	**A Bit (2)**	**Moderate (3)**	**Good (4)**	**Excellent (5)**	**Mean**
Record Audio	10	12	30	29	31	3.53
Record Video	9	14	24	33	32	3.58
Take Photo	4	8	13	30	57	4.14
Edit Video	16	14	34	31	17	3.17
Edit Audio	19	21	36	22	14	2.92
Edit Photo	12	12	28	34	26	3.45

The statistics below show the mean for the student usage of mobile devices, such as mobile phones, in developing the multimedia content to help in doing assignments: Using for building concrete experience to do assignments has a mean of 3.6, using for reflection to plan to do assignments has a mean of 3.69, using for analysing and conceptualizing to do assignments has a mean of 3.81, and, lastly, to develop the confidence to apply to do assignments has a mean of 3.79. This indicates high means for learning by experience from student-generated activities.

Table 3. Student usage of mobile devices, such as mobile phones, in developing the multimedia content to help in doing assignments

Student usage of mobile devices, such as mobile phones, in developing the multimedia content to help in doing assignments						
Criteria	**None (1)**	**A Bit (2)**	**Average (3)**	**Good (4)**	**Excellent (5)**	**Mean**
Building concrete experience to do assignments	0	9	33	55	15	3.68
Reflection to plan to do assignments	1	6	28	59	18	3.69
Analyse and conceptualize to do assignments	0	6	24	67	15	3.81
Develop confidence to apply to do other assignments	0	6	25	68	13	3.79

The statistics below show the mean for students' challenges when creating the multimedia content assignment: For wireless, the mean achieved is 3.96, phone hanged has a mean of 2.69, small mobile phone screen 3.05, editing and producing video has a mean of 3.30, and battery power has a mean of 3.38. The wireless issue is the biggest challenge for student-generated activities in learning STEM.

Table 4. Students' challenges when creating the multimedia content assignment

Students' challenges when creating the multimedia content assignment						
Criteria	**None (1)**	**A Bit (2)**	**Moderate (3)**	**Good (4)**	**Excellent (5)**	**Mean**
Wireless	7	14	35	37	31	3.96
Phone Hanged	9	23	24	31	10	2.69
Small Screen	14	21	35	29	13	3.05
Edit & Produce Video	8	18	32	40	14	3.30
Battery Power	6	21	26	43	16	3.38

Conclusion

The contribution to research is the descriptive insights of how academics and students established mobile phone practices for student-generated activities for STEM. This research showed that Malaysian university students could potentially use mobile devices, such as the multimedia functions of mobile phones, for developing content for STEM. The descriptive information on preliminary STEM mobile learning shows that student-generated activities could transform the future paradigm of future content production using mobile devices.

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