Journal of Personalized Learning, *2*(1) 2016, 40-51.

TEACHING AND LEARNING GEOMETRY USING GEOGEBRA SOFTWARE VIA MOOC

Saidatuna Miftahul Jannah Azizul
Personalized Education Research Group, Faculty of Education,
Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, MALAYSIA
smjannah2@gmail.com

Rosseni Din
Personalized Education Research Group, Faculty of Education,
Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, MALAYSIA
rosseni@ukm.edu.my

ABSTRACT

Technology in education is not something new in this era; in fact the Malaysian Ministry of Education encourages the use of technological advancement in teaching and learning. This strategy is also applied to the teaching of mathematics as teachers are highly encouraged to integrate computer aided instruction. The purpose of this study was to develop mathematics teaching materials for the topic of geometry based on GeoGebra software for Form Four students. This developmental study used a quantitative approach. Instrument used in this study are questionnaires. The instructional design model used in this research was the Reka Bangun SPP IV Model. The size of the sample was 23 students from the SMK Bandar Behrang 2020 4A class. Data was analyzed descriptively with SPSS version 22. Findings showed that this mathematics module based on GeoGebra software was usable as well as that students had a basic knowledge on the functions of MOOC elements. Therefore, the development of teaching modules in this research is expected to be resources for Form Four mathematics teachers as well as helping students understand geometry. This teaching module is integrated to a MOOC via the OpenLearning platform for the purpose of sharing widely so that anyone interested to learn will have access.

Keywords: GeoGebra; Geometry; MOOC; OpenLearning; Personalized Learning

INTRODUCTION

Integration of technology in education especially in teaching and learning mathematics is widely encouraged. The Curriculum Development Division suggests that mathematics teaching and learning should be integrated with the use of technology as well as promoted with the use of dynamic software (Ministry of Education, 2011). Previous study demonstrated that the use of technology is useful as a tool to support and transform the teaching and learning process, especially for mathematics (Abdul Saha et al., 2010). One of the recommended software to be applied in teaching and learning mathematics is GeoGebra which is used for topics related to geometry (Idris, 2009).

Geometry is one of the topics in mathematics with abstract learning (Hutkemri & Zakaria, 2014). Learning which involves abstract concepts is more difficult than learning concrete concept (Tutkun & Ozturk, 2013). Learning mathematics, particularly related to geometry, using dynamic geometry software can help students improve their understanding of definitions of geometric concepts (Erbas & Yenmez, 2011). Module of teaching and learning mathematics for Form Four students based on the GeoGebra software that has been used in this study was prepared for teachers to support effective learning. The materials was developed and then shared through a MOOC by using the OpenLearning platform. This platform not only allows teachers but also students to access the shared material by joining this online course and consequently enables them to interact with other learners. This article focuses on the use of dynamic geometry software GeoGebra in teaching and learning mathematics especially for topics related to geometry and to understand the practice of personalized learning among learners.

Many dynamic geometry software have been introduced in mathematical education and one of them is GeoGebra. GeoGebra can help student understand topics of mathematics related to geometry (shape) and

To cite this document:
Azizul, S. M. J., & Din, R. (2016). Teaching and learning geometry using geogebra software via mooc. *Journal of Personalized Learning*, *2*(1): 39-50.

make mathematics learning meaningful (Idris, 2009). Furthermore the software allows students to explore the elements of geometry equipped with various functions that are suitable with its dynamic environment (Abdul Saha et al., 2010). Indirectly, this leads students to personalize their learning as they interact with the software itself in the process of teaching and learning. This is because one of personalized learning's characteristics is the presence of the student's own initiative (Abdul Manaf et al., 2015).

Past studies have shown the effectiveness of GeoGebra in teaching and learning mathematics. Erlina and Zakaria (2014) studied the effectiveness of this software in solving problems related to geometry. The effects also can be seen on student's geometric thinking through Van Hiele model (Abdul Rahman, 2014; Idris, 2009; Tutkun & Ozturk, 2013). Besides, Abdul Saha et al. (2010), Tutkun and Ozturk (2013) along with Erlina and Zakaria (2014) conducted various studies on the effectiveness of GeoGebra towards academic achievement. Despite its benefits, this software is not widely used among mathematics teachers in Malaysia (Arbain & A. Shukor, 2015) and more efforts should be taken to encourage the use of GeoGebra for personalized learning.

Despite the vast potential of technology in assisting students' learning in mathematics, previous studies showed that many mathematics teachers are not using technology in their teaching and learning process due to constraint in the current system of education, attitude of teachers and students towards technology, lack of resources, and lack of skills in handling technology (Aksan & Eryilmaz, 2011). Another factor identified in the literature is the lack of exposure given to the teachers regarding teaching materials based on technology (Md. Khambari et al., 2010). Beneficial technological resources for teaching materials should be made available so that teachers are motivated to use the technology in their teaching and learning process (Abdul Saha et al., 2010). Thus, the study aimed:

(i) To identify the usability level of teaching module based on the GeoGebra software for mathematics for Form Four students from the end user perspective.
(ii) To identify the level of understanding towards the functions of elements from MOOC via OpenLearning among Form Four students.

Geogebra In Mathematics Teaching and Learning
GeoGebra is a freely available dynamic software for teaching and learning mathematics with features that are suitable for topics such as geometry and algebra. According to Abdul Saha et al. (2010), this dynamic software was developed by Markus Hohenwarter and has now been translated into more than 40 languages. This software was designed as a combination of other geometry dynamic software features such as Cabri Geometry and Geometer's Sketchpad (Hohenwarter et al., 2009) and is more interactive compared to other geometric softwares (Wan Salleh & Sulaiman, 2013). The learning process that is related to geometry is one of the mathematics contents that is concerned with the integration of technology during the teaching and learning process (Khaeroni, 2012). GeoGebra is suitable to be used as an alternative teaching aid that is based on technology (Hutkemri & Zakaria, 2014). It is not only suitable for geometrical learning but also for topics related to algebra and calculus (Wan Salleh & Sulaiman, 2013). GeoGebra is dynamic geometry software (Figure 1) fitted with various characteristics that allow users to construct object such as points, segments, lines, circles, ellipses, angles and other dynamic functions (Khaeroni, 2012).

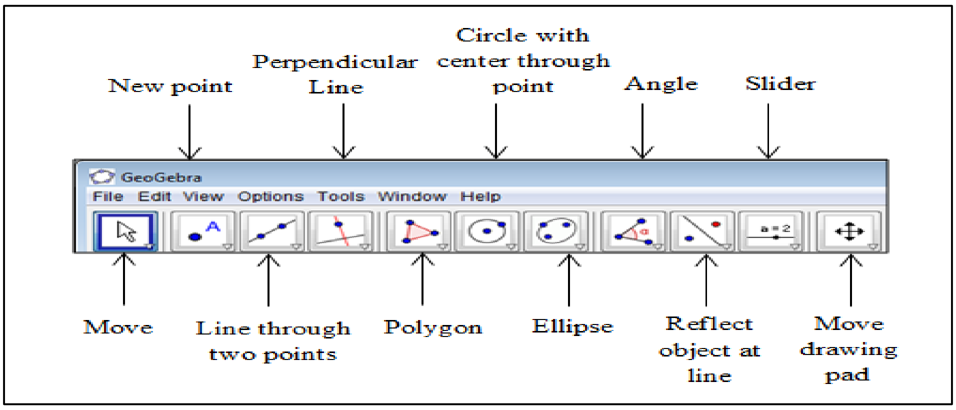

Figure 1. Functions of the GeoGebra software

Journal of Personalized Learning, *2*(1) 2016, 40-51.

GeoGebra is an open source software that is available for free by simply downloading the software from its website www.geogebra.org (Wan Salleh & Sulaiman, 2013; Zengin et al., 2012). The software was first designed in 2001 by Markus Hohenwarter (Zengin et al., 2012). GeoGebra software is also able to help teachers improve students' understanding of mathematical concepts and procedures as this software offers mathematical functions like symbols, graphs and many more (Hutkemri & Zakaria, 2014). It is convenient for students with diverse ability levels, in fact one of its advantages is its ability to give clear information through figure and graphic which is very essential in understanding mathematics concepts.

Moreover this software is user-friendly as its features can link geometric representations, algebra and numbers (Wan Salleh & Sulaiman, 2013). Considering geometry as a learning abstract concept which is much more complicated than concrete concepts, the right teaching process should be implemented to improve students' understanding (Tutkun & Ozturk, 2013). Teaching modules based on GeoGebra allow student to use their previous knowledge towards new knowledge by reinforcing what is included in the module (Hutkemri & Zakaria, 2014). Besides, GeoGebra is a dynamic mathematics software that can act as a tool that helps teacher designing effective teaching (Arbain & A. Shukor, 2015).

The effectiveness of GeoGebra in improving the students' understanding in geometry has been proven by previous studies. One of them is a study conducted by Tutkun dan Ozturk (2013) about the effect of the mathematics software GeoGebra towards academic achievement and Van Hiele level of geometric thinking. The geometric topics that are involved in this study are trigonometry and gradient. Findings showed that students' achievements were higher among those who learned using the dynamic geometry software compared to students who learned without GeoGebra. The study also agreed that applications based on technology especially GeoGebra help effective teaching and learning. Meanwhile, a study by Wan Salleh and Sulaiman (2013) reviewed the effectiveness of GeoGebra's usage towards lecturers' mathematics conceptual and procedural knowledge. The topics that were involved were the application of differentiation and integration. Findings showed that the application of GeoGebra improved conceptual understanding. Other than that, the use of technology especially GeoGebra may help improve and stabilize knowledge for lecturers in the topics of application of differentiation and Integration. Mathematics concept can easily be accepted and systematically. In other words, technology helps lecturers in understanding the relationship between conceptual and procedural knowledge.

Zengin et al. (2012) conducted experimental research in order to identify the effect of using the mathematics dynamic software GeoGebra towards achievement in the subtopic of trigonometry functions and graphs of trigonometry functions. Findings showed that learning using GeoGebra gives a meaningful impact for students who learned in the experimental group. Overall, the research concluded that students who learned trigonometry with GeoGebra had better achievement than those who learned with a constructivist approach. Results from research conducted by Erbas and Yenmez (2011) also highlight the effectiveness of using the dynamic geometry software towards academic performance particularly for topics on polygons. Overall, these findings demonstrated that students in experimental group had better performance than students in control group. In addition, through this study researchers discovered that students who learned using the dynamic geometry software were more inquisitive and demonstrated more active learning in classroom compared to students who learned using a traditional approach.

Abdul Saha et al. (2010) discovered that the group who learned using GeoGebra had significant better achievements than the group who learned with a traditional approach. Furthermore, GeoGebra is a software that is suitable for students with diverse visualization skills to learn geometric concepts in a convenient way. Reis and Ozdemir (2010) used GeoGebra as a technological tool for instructional method for parabolas. The outcome from the data analyzed showed that students can learn meaningfully with GeoGebra. As a summary, teaching using materials based on GeoGebra are more successful than traditional methods. Refer Table 1 as below for a brief statement of past studies on the effectiveness of GeoGebra.

Table 1**.** Summary of Past Studies Regarding the Effectiveness of GeoGebra.

Researcher	Topic	Variable	Note
Tutkun and Ozturk (2013)	Trigonometry and gradient	Independent variable -Effect of GeoGebra usage. Dependent variable -achievement and geometry thinking test.	Integration of GeoGebra with Van Hiele geometric thinking test.
Wan Salleh & Sulaiman (2013)	Differentiation and integration	Independent variable -Effectiveness of GeoGebra. Dependent variable -Lecturer's mathematics conceptual knowledge and procedural.	Teaching module based on GeoGebra for topic differentiation and integration conducted via workshop.
Zengin et al. (2012)	Trigonometry	Independent variable -effect of using dynamic software GeoGebra. Dependent variable -Achievement in subtopic of trigonometric function and graph of trigonometric function.	Workshop held for five weeks covered 12 GeoGebra activities.
Erbas and Yenmez (2011)	Polygons	Independent variable -effect of GeoGebra usage. Dependent variable -student achievement on Polygon topic.	Group work with dynamic geometry environments conducted in a computer laboratory.
Abdul Saha et al. (2010)	Coordinate geometry	Independent variable -Effect of GeoGebra usage. Dependent variable -mathematics achievement.	Test increase of spatial visualization ability (SVATI) on student using GeoGebra.
Reis and Ozdemir (2010)	Parabola	Independent variable -Effect of using dynamic software GeoGebra. Dependent variable -Achievement test on Parabola.	Materials based on GeoGebra involving parabola section, tutorials and example in daily life.

Massive Open Online Course (MOOC) and Mathematics Education

The development of module for teaching and learning mathematics for Form Four students based on GeoGebra are prepared as a source for teachers' reference and to assist them for meaningful learning. The materials that have been developed are then uploaded to the biggest open online course which is a MOOC using the OpenLearning platform. By doing this it may allow teachers and students to easily get the materials by simply joining the course. They also have the opportunity interact with other learners from diverse backgrounds.

A MOOC is an online learning platform that can be accessed globally and which can accommodate a large number of learners (Weller & Anderson, 2013) as well as offering various courses according to individual needs (KPM, 2015). Beside that the courses are open to all, freely accessible and ubiquitous (Atenas, 2015; Baturay, 2015; Chen, 2013). MOOCs are open to anyone who is interested in enrolling in the course (Atenas, 2015). MOOCs offer many courses with flexible learning subjected to the learners own pace (Cripps, 2014). Moreover, it is also unbounded by time (Cripps, 2014). Learning through a MOOC is suitable for those who prefer personalized learning environments.

A software integrated in teaching and learning mathematics through MOOC is able to produce a generation of tech-savvy and broad-minded users. This is because GeoGebra is not only a dynamic software that develop constructive skills, but also enhances individual creativity (Erlina & Zakaria, 2014; Syairatul, 2014). Moreover sharing modules through a MOOC allow learners to share their views with each other and improves software-related activities along with the change in time as its characteristics are interactive (Weller & Anderson, 2013; Baturay, 2015).

Personalized Learning and Mathematics Education
Learning using GeoGebra for teaching and learning geometry encourages personalized learning for students if teachers wisely adapt the environment and the surroundings to suit the students. Personalized learning environment are designed to eliminate the limitation of other learning environment (Sahin & Kisla, 2016). For Redding (2016), personalized learning is not just about individualization or personal which involves only students' prior knowledge and readiness to receive new knowledge. Personalized learning also aims to understanding student from the perspective of personal preferences, interest as well as benefits from the understanding (Redding, 2016). The most suitable methods are important in order to yield meaningful personal experiences towards students as well as possible (Albano et al., 2015).

Students' attitudes towards personalized learning environments are essential to determine their behavior (Sahin & Kisla, 2016). Student not only seat on their chair, stay at their desk and listen to whatever is delivered by teachers, instead alternative learning is aided by software for learning management switch from simple to planning interactive activities for teaching and learning (Redding, 2016). The activities should be compatible so that students are able to continue doing the activities according to their own time, place and pace outside of school (Redding, 2016). Therefore all parties in education should participate in the environmental development to improve the effectiveness of personalized learning environments (Sahin & Kisla, 2016).

According to the Ministry of Education (2011), the use of software indeed is a way of delivering mathematics content particularly dynamic geometry software. Furthermore they also want to uplift the standard of education in Malaysia to ensure skilled teachers integrate technology in teaching and learning (KPM, 2013). Teachers and students can experience the pleasure of teaching and learning. In addition, the resulting modules can be suggested by the Ministry of Education to schools as references and teaching aids for teachers. According to Din (2015), personalized learning is any teaching and learning methods that allow learners to experience the learning by taking into account the learners' needs. One of these is the ability to learn through modules at one's own pace.

Conceptual Framework of The Study
This part provides the definition of GeoGebra, the effectiveness of GeoGebra, the definition of the term MOOC and personalized learning based on the literature review of previous studies. Three learning theories have been used in this study for the preparation of a mathematics teaching module based on the GeoGebra software for Form Four student. The theories are the social learning theory, the cognitive load theory the and minimalist theory. The instructional design model used in this study is the RekaBangun SPP IV Model. The conceptual framework is presented in Figure 2.

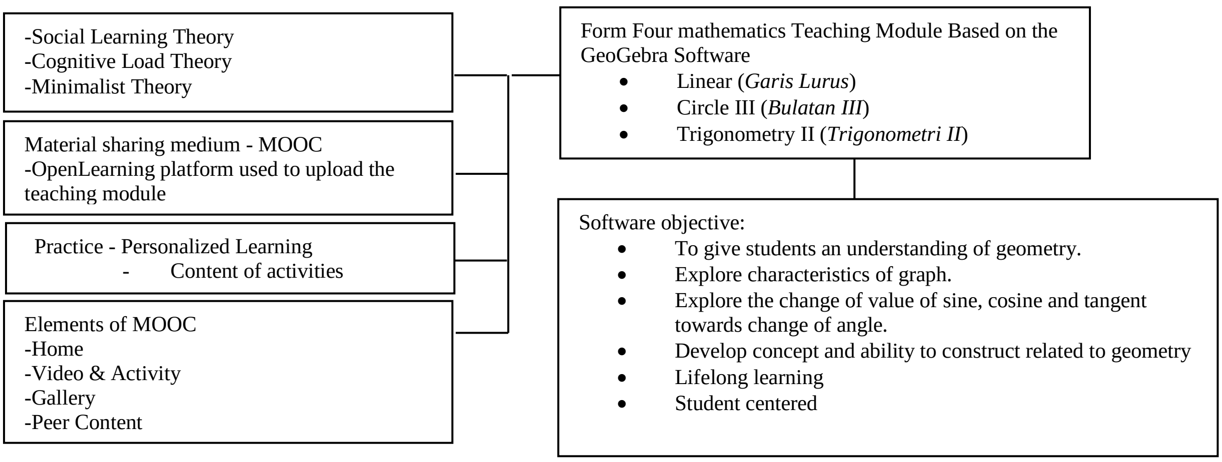

Figure 2. Conceptual framework of the study.

METHODOLOGY

This study is a developmental study that uses a quantitative method. The research design was employed to access descriptive data for usability of teaching and learning mathematics module using the GeoGebra software. Target sampling for this study is form four students of Sekolah Menengah Kebangsaan Bandar

Behrang 2020. Random sampling is used in this study. The selected class for the sample of this study is Class 4A because this was an excellent class in term of its academic level, and because, as described by their teacher, they actively participated during the teaching and learning process. These students were selected as they were available at the time of the study, and because the number of students was sufficient. A total of 23 students from 4A Class were selected randomly. Only 23 students were selected from the students in Form Four, as according to Din (2014) for a usability test in the implementation phase for design and development of teaching system, a minimum of three to five respondents is adequate by considering several factors such as time and cost. However, it is better if there are more respondents. The instrument used for this study was a questionnaire.

Data Collection Methods

Data was collected at SMK Bandar Behrang 2020 when the Form Four mathematics teaching and learning session took place. A total of 23 randomly selected students were brought to the Computer Laboratory to be taught using the learning module prepared by the researcher with the GeoGebra software. Some of the constraints in the computer laboratory were that there were only 22 computers available and two of the computers did not function well. Because of this issue, a couple of students needed to share one computer and completed the activities together. Students received the activity from the module via OpenLearning which is the MOOC platform used by the researcher. Students need to register on OpenLearning and join the "Fun with GeoGebra" course. Researcher distributed the questionnaire on the usability of the module after students completed the task from the module. Students play an important role as end users for the product developed by the researcher.

Instrument of The Study

The questionnaire was developed and adapted from an instrument developed by Din (2010). The questionnaire was divided into three parts. Part A was for demographic data, Part B for usability of GeoGebra module, while Part C for elements of MOOC. The questionnaire was verified by experts and the items were certified as able to measure constructs by regarding the objective of the study. The list of constructs and the number of items according to the respective parts are as follows:

(i) Part A – Demographic data (Gender, age and race)
(ii) Part B – Usability of the GeoGebra module

Table 2. Construct and Number of Item for Part B

Construct	Number of item
GeoGebra Advantage	4 items (1 – 4)
Activities Content	5 items (5 – 9)
Technical	6 items (10 – 15)

(iii) Part C – Element of MOOC

Table 3. Construct and Number of Item for Part C

Construct	Number of item
Home (Announcement)	5 items (16 – 20)
Video and activities	5 items (21 – 25)
Gallery	5 items (26 – 30)
Peer content	5 items (31 – 35)

Scoring and Measurement

The questionnaire used a five-point Likert scale for all items. All the five points were labeled starting with 1 (Strongly Disagree), 2 (Disagree), 3 (Slightly Agree), 4 (Agree) and concluded with 5 (Strongly Agree). Data was analyzed descriptively by viewing mean and standard deviation for every construct of the instrument. Data was analyzed using SPSS version 22. Refer to table 4 for mean interpretation of the five-point Likert scale.

Table 4. Mean Interpretation for Five-Point Likert Scales

Mean score	Intepretation
1.00 to1.89	Strongly Disagree
1.90 to 2.69	Disagree
2.70 to 3.49	Slightly Agree
3.50 to 4.29	Agree
4.30 to 5.00	Strongly Agree

Source: Bahagian Perancangan dan Penyelidikan Dasar Pendidikan (BPPDP) (2006). Pelan Induk Pembangunan Pendidikan (PIPP). Kuala Lumpur, Malaysia.

Advantage, Activities Content and Technical Aspects of Geogebra As Perceived By The End Users

Data was analyzed descriptively in order to get the mean, the standard deviation and the level. The five-point Likert scale used in this part is divided into four levels which are low, medium low, medium high and high. Refer table 5:

Table 5. Mean Score Interpretation into Four Levels (Five-Point Likert Scale)

Mean score	Level
1.01 – 2.00	Low
2.01 – 3.00	Medium low
3.01 – 4.00	Medium high
4.01 – 5.00	High

Source: Stufflebeam (1971)

FINDINGS AND DISCUSSION

This section discusses the findings that were analyzed from the questionnaire given to the respondents. Data was analyzed descriptively in order to get the central tendency of mean and standard deviation. The findings were organized into usability level of teaching module based on the GeoGebra software for mathematics Form Four from the end users' perspective, and the students' knowledge of the functions of elements from the MOOC via OpenLearning.

Advantages of GeoGebra Software

This part explains the usability of the module in the aspect of the advantages of the GeoGebra software. There are four items in this part. Every item is represented by its item number KG1, KG2, KG3 and KG4. Data was analyzed by viewing the mean score and standard deviation in order to identify the level of usability of the GeoGebra module based on the advantages of the software. Findings are reported in Table 6.

Table 6. Mean, Standard Deviation and Level of Advantages of the GeoGebra Software

Item no.	Items	Mean	Standard Deviation	Level
KG1	GeoGebra software is easy to learn.	4.39	0.583	High
KG2	GeoGebra encourage me to do activity.	4.39	0.583	High
KG3	GeoGebra help in understanding the concept of geometry.	4.17	0.778	High
KG4	GeoGebra can be used for geometry topics. (Example: straight line, circle and trigonometry)	4.52	0.593	High
	Total item mean	4.37	0.634	High

Based on Table 6 the overall mean score for the advantages of GeoGebra is at the high level. Mean value for the total items of the advantages of the GeoGebra software is 4.37 (SP = 0.634). The high mean score (4.01 and above) shows that the majority of students agreed with the statement regarding the advantages of the GeoGebra software. This shows that students agreed that GeoGebra can be used for topics related to geometry such as straight lines, circle III and trigonometry II. The standard deviation value for all items in this part did not exceed and was not equal to 1.0 which means that the scattering of the response was not wide.

Activities Content of The GeoGebra Module

This section relates the usability of the activities content of the GeoGebra module. There are five items in this part. Each item is represented by the item number KA1, KA2, KA3, KA4 and KA5. Data was analyzed by viewing the mean score and the standard deviation in order to identify the level of usability of the content of activities that were available in the GeoGebra module. Results are reported in Table 7.

Table 7. Mean, Standard Deviation and Level for Activities Content

Item no.	Item	Mean	Standard deviation	Level
KA1	I learned better with GeoGebra's help.	4.43	0.662	High
KA2	I am to achieve the objective of the activity.	4.17	0.650	High
KA3	Objectives stated are easy to understand.	4.13	0.694	High
KA4	Reinforcement helps me master the geometry concept.	4.13	0.458	High
KA5	I have fun learn using GeoGebra.	4.57	0.590	High
	Total item mean	4.29	0.611	High

Table 7 shows the mean score, the standard deviation and the level of usability of activities content that were found in the module. As a whole, the mean score for the activities content ranges from 4.13 to 4.57. The overall mean value for the construct of activities content is 4.29 (SP = 0.611). This shows that students have fun learning with GeoGebra. The level of usability for activities content of the module is high.

Technical Aspects of GeoGebra

This technical part describes the data on the usability of the module from a technical aspect. There are six items in this part. Every item was represented with the item numbers T1, T2, T3, T4, T5 and T6. Data was analyzed by viewing the mean score and the standard deviation for every item. The level for each item in the construct can be determined by interpreting from the mean score of all items. Findings are reported in Table 8.

Table 8. Mean, Standard Deviation and Level for the Technical Aspect

Item no.	Item	Mean	Standard deviation	Level
T1	Illustrations and instructions in the module are clear.	4.17	0.576	High
T2	Language used is easy to understand.	4.04	0.638	High
T3	Video of module helps students learn better.	4.26	0.541	High
T4	Steps of activities in the module can be followed easily.	4.39	0.722	High
T5	Audio used is clear (not distracting).	4.13	0.815	High
T6	Graphic (picture) used help understand the module.	4.35	0.647	High
	Total item mean	4.22	0.657	High

Table 8 shows the mean score, the standard deviation and the level of module usability from a technical aspect. As a whole, the mean score for activities content ranges from 4.04 to 4.39. Overall mean values for the technical aspect is 4.22 (SP = 0.657). These results show that the majority of students can use the module of mathematics teaching and learning based on GeoGebra as steps of activities in the module can easily be followed. As a conclusion the level of GeoGebra module usability from a technical aspect is high.

Student's Knowledge Level Towards The Functions of Elements From A MOOC Via Openlearning

The elements of MOOC are from Part C of the questionnaire used. This part is in response to the second objective of the study. Data was analyzed descriptively in order to view the mean and standard deviation values. Next, the students' level of knowledge towards functions of elements from OpenLearning was identified based on the interpretation from the mean score (as in Table 5). This part of the MOOC elements is divided into four elements. The elements are (i) Home (Announcement), (ii) Video and Activities, (iii) Gallery and (iv) Peer Content. Analysis of data and findings can be seen in Tables 9 through 12.

Home (Announcement)

Home is one of the elements in OpenLearning that brings students to the main page of a course. This page is also a page for teachers or administrators to make an announcement to the course participants. To identify whether students knew the function of this Home (Announcement) page, several items on it were included in the questionnaire that was given to them. This part has five items which are represented as H1, H2, H3, H4 and H5. Data was analyzed descriptively to view mean and standard deviation for every item in order to identify the students' knowledge of the functions of Home (Announcement). Findings are displayed in Table 9 below:

Table 9. Mean, Standard Deviation and Level for the Home Element

Item no.	Item	Mean	Standard deviation	Level
H1	This space is sufficient for announcement.	3.78	0.671	Medium high
H2	This space is not messy.	3.96	0.825	Medium high
H3	Has meaningful function in delivering information.	4.48	0.511	High
H4	Uses a suitable page view.	4.09	0.596	High
H5	Good space to make an announcement.	4.04	0.706	High
	Total item mean	4.07	0.662	High

Based on Table 9 the overall mean score shows that a majority of students agreed with the items for Home element. The mean value for Home element is 4.07 (SP = 0.662).. This shows that students agreed that Home is an element that has meaningful functions in delivering information.

Video and Activity

Next, the researcher identifies the students' knowledge of the functions of the second element which is video and activity. This part has five items that are represented as VA1, VA2, VA3, VA4 and VA5. Data was analyzed descriptively to view the mean and standard deviation for every item in order to identify the student's knowledge of the functions of Video and Activity. Findings are as displayed in Table 10.

Table 10. Mean, Standard Deviation and Level for the Video and Activity Element

Item no.	Item	Mean	Standard deviation	Level
VA1	Space for material of module.	4.30	0.470	High
VA2	Equipped with reinforcement.	4.39	0.656	High
VA3	Video is suited to the activity in the module.	4.22	0.422	High
VA4	Video provided is helpful.	4.09	0.515	High
VA5	This space is needed to ease students.	4.65	0.487	High
	Total item mean	4.33	0.510	High

Based on Table 10, as a whole, most students agreed with the items regarding the function of the Video and Activity element. This means that most of the students knew the Video and Activity function in OpenLearning. The overall mean for the item is 4.33 (SP= 0.510). The item with the highest mean score is the fifth item with a value of 4.65 (SP= 0.487). The item with the lowest mean score is the fourth item with a value of 4.09 (SP = 0.515).

Gallery

The third element of the MOOC is the Gallery. This part has five items that are represent as G1, G2, G3, G4 and G5. Data was analyzed descriptively to view the mean and standard deviation for every item in order to identify the students' knowledge of the functions of the Gallery in OpenLearning. Findings are displayed in table 11.

Table 11. Mean, Standard Deviation and Level for the Gallery Element

Item no.	Item	Mean	Standard deviation	Level
G1	I know all my activities will be in the gallery	3.96	0.878	Medium high
G2	This gallery is needed to see peers' responses	4.13	0.815	High
G3	This space enhances interaction.	4.13	0.626	High
G4	This space allows me to view peers' work.	4.35	0.647	High
G5	This gallery is suitable for the learning purposes.	4.61	0.583	High
	Total item mean	4.24	0.701	High

Table 11 shows the mean score, the standard deviation and the level of the students' knowledge of the function of the Gallery element. As a whole, the mean score for the gallery ranges from 3.96 to 4.61. The overall mean value for the Gallery element is 4.24 (SP = 0.701). These show that the majority of students know that this space is suitable for the learning purposes.

Peer Content

The fourth element is Peer Content. This part has five items that are represented as PC1, PC2, PC3, PC4 and PC5. Data was analyzed descriptively to view the mean and standard deviation for every item in order to identify the students' knowledge the functions of Peer Content in OpenLearning. Findings are displayed in Table 12.

Table 12. Mean, Standard Deviation and Level for Peer Content

Item no.	Item	Mean	Standard deviation	Level
PC1	I know this space is for sharing.	4.09	0.996	High
PC2	I can share anything.	4.13	0.815	High
PC3	Beneficial as student can learn from peers.	4.57	0.662	High
PC4	This space is interesting.	4.57	0.507	High
PC5	I am interested to interact with peers in this space.	4.74	0.449	High
	Total item mean	4.42	0.686	High

Table 12 shows the mean score, the standard deviation and the level of students' knowledge on the function of Peer Content in OpenLearning. As a whole, the mean score for Peer Content ranges from 4.09 to 4.74. The overall mean value for Peer Content is 4.42 (SP = 0.686). This shows that the majority of students are interested in interacting with peers in this space.

The findings that have been presented are related to the first and second objectives of this study as stated in the Introduction section of the article. The first relates to the usability level of the module for teaching and learning based on the GeoGebra software for mathematics in the Form Four students' perspective. The second relates to the students' knowledge of the functions of the elements in the MOOC on the OpenLearning platform.

In term of usability, GeoGebra can be used for topics related to geometry for instance straight lines, circle III and trigonometry II. These three topics are related to the form four syllabuses in geometry in mathematics based on curriculum specification from the Ministry of Education. Findings also showed that this software is not only easy to use but also helps students understand the concept of geometry. This statement is supported by Abdul Saha el at. (2010) as GeoGebra can enhance the visualization ability of students to understand geometry. The software is easy to use because it is equipped with features and functions that are user-friendly (Wan Salleh & Sulaiman, 2013). Moreover, learning-aided software is generally able to help students to better carry out activities (Hutkemri & Zakaria, 2014). Arbain and A. Shukor (2015) suggest that teachers should maximize the use of existing technologies like GeoGebra. According to Tutkun and Ozturk (2013), any material or technique that can enhance the students' understanding of abstract concepts in mathematics teaching should be used.

In the aspect of the MOOC's elements, students were exposed to functions from different pages such as Home, Video and Activity, Gallery and Peer Content. Most of the students knew the purpose of every page in OpenLearning and were interested to use them as a medium to share knowledge and to interact with peers. The flexible characteristics of MOOCs (Cripps, 2014) are suited to encourage a personalized learning style. This is because personalized learning allows student to learn in accordance with their own time, as it adjusts to the students' comforts. Moreover, personalized learning is geared to learning aided with software rather than in a traditional way (Redding, 2016). Therefore, it is expected that learning mathematics with GeoGebra will reach out to many people that are interested to learn this subject with the existence of a wide knowledge sharing medium such as a MOOC using the OpenLearning platform. A MOOC is a medium that can nurture interactions among learners from the viewpoint of education (Sanchez-Vera & Prendes-Espinosa 2015). According to Cripps (2014), some students thought that learning through a MOOC is very efficient and effective. This is because they view the courses offered on MOOCs as attractive, easy and they can use them at anytime that suits their pace (Cripps, 2014).

Journal of Personalized Learning, *2*(1) 2016, 40-51.

CONCLUSION

This study benefits students, teachers, the Ministry of Education as well as other researchers. From the students' perspective, the implication of this study is that students are now able to get resources or learning material on geometry based on the GeoGebra software. Moreover, students will be able to explore new subjects and apply personalized learning. From the teachers' perspective, this is an opportunity to try a new alternative to the delivery of teaching. Modules can be used and shared with other educators so that everyone may benefit from the sharing of knowledge. This should encourage creativity in preparing material and in designing instructional teaching aids. From the perspective of the Ministry of Education, this study has a good impact in the field of education as it encourage teachers, especially mathematics teachers, to practice innovation in teaching and learning consistently with the government's expectations. In addition, it also inculcates a healthy competition in the education world in order to always be progressive in creating innovation and in the use of technology in education.

The objectives of this study have been accomplished based on the findings that have been analyzed. A mathematics teaching module based on the GeoGebra software can be use in teaching and learning. The module is not limited to teachers and students but is also available to those interested to use and learn with it. This is due to the fact that the materials that have been shared via a MOOC, the largest medium of knowledge sharing in the world are widely accessible, open to everyone, flexible and free. A suggestion for further study for improvement would be on sampling, because due to restraints in term of time and availability the sample of this study was limited. Improvements can also be made by developing modules and videos in English rather than in Malay. This is essential to attract more learners who are interested to learn the course from all around the world. A future direction to further this study could be undertaken on the aspect of effectiveness of the module towards the users. In conclusion, this study is expected to be beneficial to all parties involved.

References

Abdul Manaf, S. Z., Din, R., Hamdan, A., Mat Salleh, N. S., Kamsin, I. F., Karim, A. A., Mohd Fauzi, I. F., Zaid, A. S., & Ismail, N. M. (2015). Pembelajaran Peribadi Melalui Teknologi ICT Abad ke-21 ke Arah Kemahiran Boleh Pindah. *Journal of Personalized Learning*, *1*(1), 57–68. (*In Malay)*

Abdul Saha, R., Mohd Ayub, A. F., & Ahmad Tarmizi, R. (2010). The Effects of GeoGebra on mathematics Achievement : Enlightening coordinate geometry learning. *International Conference on Mathematics Education Research 2010* (ICMER 2010) (pp. 686–693). Malacca, Malaysia.

Aksan, E., & Eryilmaz, S. (2011). Why don't mathematics teachers use instructional technology and materials in their courses ? *Procedia Social and Behavioral Sciences*, 15, 2471–2475.

Albano, G., Miranda, S., & Pierri, A. (2015). Personalized Learning in mathematics. *Journal of E-learning and Knowledge Society*, *11*(1), 25–42.

Arbain, N., & A. Shukor, N. (2015). The effects of GeoGebra on students achievement. *Procedia - Social and Behavioral Sciences*, *172*, 208–214.

Atenas, J. (2015). Model for democratisation of the contents hosted in MOOCs. *Universities and Knowledge Society Journal*, *12*(1), 3–14.

Bahagian Perancangan dan Penyelidikan Dasar Pendidikan (BPPDP). (2006). *Pelan Induk Pembangunan Pendidikan (PIPP)*. Kuala Lumpur, Malaysia. (*In Malay*)

Baturay, M. H. (2015). An overview of the WORLD of MOOCs. *Procedia - Social and Behavioral Sciences*, *174*, 427–433.

Chen, J. C. (2013). Opportunities and challenges of MOOCS : Perspectives from Asia. *IFLA WLIC 2013* (pp. 1–16). Taiwan, China.

Cripps, T. (2014). " It's my challenge": Exploring the MOOC terrain. *Proceedings of CLaSIC 2014*, 89–102. Nanzan University, Japan.

Din, R. (2010). *Development and validation of an integrated meaningful hybrid e-Training (I-MeT) for computer science: Theoretical-empirical based design and development approach*. Doctoral thesis. Bangi: Universiti Kebangsaan Malaysia.

Din, R. (2014). *Pembinaan & Permodelan Sistem Pengajaran*. Bangi: Penerbit Universiti Kebangsaan Malaysia. (*In Malay*)

Erbas, A. K., & Yenmez, A. A. (2011). The effect of inquiry-based explorations in a dynamic geometry environment on sixth grade students' achievements in polygons. *Computers & Education*, 57, 2462–2475.

Erlina, A., & Zakaria, E. (2014). Kesan penggunaan perisian geogebra ke atas keupayaan penyelesaian masalah dan pencapaian matematik pelajar. *Jurnal Pendidikan Matematik, 2*(1), 51–64. (*In Malay*)

Hohenwarter, M., Jarvis, D., & Lavicza, Z. (2009). Discussion paper linking geometry, algebra, and mathematics teachers: GeoGebra software and the establishment of the International GeoGebra Institute. *International Journal for Technology in Mathematics Education*, *16*(2), 83–86.

Hutkemri & Zakaria, E. (2014). Impact of using Geogebra on students' conceptual and procedural knowledge of limit function. *Mediterranean Journal of Social Sciences*, *5*(23), 873–881.

Idris, N. (2009). The Impact of using Geometers' Sketchpad on Malaysian students' achievement and Van Hiele geometric thinking. *Journal of Mathematics Education*, *2*(2), 94–107.

Kementerian Pelajaran Malaysia. (2011). *Kurikulum Bersepadu Sekolah Menengah Spesifikasi Kurikulum*. Putrajaya: Kementerian Pelajaran Malaysia. (*In Malay*)

Kementerian Pendidikan Malaysia. (2013). *Pelan Pembangunan Pendidikan Malaysia 2013-2025 (Pendidikan Prasekolah hingga Lepasan Menengah)*. Putrajaya: Kementerian Pelajaran Malaysia.

Kementerian Pendidikan Malaysia. (2015). *Ringkasan Eksekutif Pelan Pembangunan Pendidikan Malaysia 2015-2025 (Pendidikan Tinggi)*. Putrajaya: Kementerian Pendidikan Malaysia. (*In Malay*)

Khaeroni. (2012). Pembelajaran Geometri SD/MI Menggunakan GeoGebra. *Primary*, *4*(1), 85–102. (*In Malay*)

Md. Khambari, M. N., Luan, W. S. & Mohd Ayub A. F. (2010). Technology in mathematics teaching: The pros and cons. *Procedia - Social and Behavioral Sciences*, *8*, 555–560.

Redding, S. (2016). Competencies and personalized learning. In M. Murphy, S. Redding, & J. Twyman (Eds.), *Handbook on personalized learning for states, districts, and schools* (pp. 3-18). Philadelphia, PA: Temple University, Center on Innovations in Learning. Retrieved from www.centril.org

Reis, Z. A., & Ozdemir, S. (2010). Using GeoGebra as an information technology tool : Parabola teaching. *Procedia - Social and Behavioral Sciences*, *9*, 565–572.

Sahin, M., & Kisla, T. (2016). An analysis of university students' attitudes towards personalized learning environments. *The Turkish Online Jornal of Educational Technology*, *15*(1), 1–10.

Sánchez-Vera, M. del M. & Prendes-Espinosa, M. P. (2015). Beyond objective testing and peer assessment: alternative ways of assessment in MOOCs. *RUSC. Universities and Knowledge Society Journal*, *12*(1), 119.

Stufflebeam, D. I. (1971). The relevance of CIPP evaluation model for educational accountability. *Journal of Research and Development in Education*, 5(1), 19-25.

Syairatul Nadiah Abd Rahman. (2014). *Keberkesanan pembelajaran matematik menggunakan GeoGebra terhadap pembentukan pemikiran geometri murid*. Tesis Sarjana, Universiti Teknologi Malaysia.

Tutkun, O. F., & Ozturk, B. (2013). The effect of Geogebra mathematical software to the academic success and the level of Van Hiele geometrical thinking. *International Journal of Academic Research*, *5*(4), 22–28.

Wan Salleh, M., & Sulaiman, H. (2013). A survey on the effectiveness of using GeoGebra software towards lecturers ' conceptual knowledge and procedural mathematics. *Proceedings of the 20th National Symposium on Mathematical Sciences*, (pp. 330–336). Putrajaya, Malaysia.

Weller, M., & Anderson, T. (2013). Digital resilience in higher education. *European Journal of Open, Distance and e Learning*, *16*(1), 53–66. Retrieved from http://www.eurodl.org/?p=current&sp=full&article=559

Zengin, Y., Furkan, H., & Kutluca, T. (2012). Social and the effect of dynamic mathematics software GeoGebra on student achievement in teaching of trigonometry. *Procedia - Social and Behavioral Sciences*, *31*, 183–187.