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Research Article

Teachers' Status of GeoGebra Use in The Teaching of Geometric Transformation

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Abstract: This study investigates teachers' perspectives towards the eventual use of GeoGebra as a tool to enhance the learning of Geometric Transformation. Study participants included 98 secondary mathematics teachers in a district of Northern Malaysia. A mixed-methods approach with closed-ended and open-ended questionnaires was employed in this study. Data analysis was performed descriptively and via thematic content analysis. The finding reveals that only 15.3% of teachers use GeoGebra in their mathematics classroom even though teachers are of the view that their students have difficulties in learning geometry, and the use of GeoGebra has been recommended by the Malaysian Mathematics Curriculum and provided in textbooks. Some challenges in using GeoGebra, including lack of competency, exposure, and experience in operating GeoGebra, facilities, and times constraints. It is recommended that module development and training programs should adequately provide teachers to use GeoGebra to teach effectively in Geometric Transformation.

Keywords: Challenges, GeoGebra, Geometric Transformation.

1. Introduction

The explosion of the Industrial Revolution 4.0 has led to many changes to the world including the world of mathematics education. Mathematics education has also undergone a shift from teachers -centred learning to students-centred by integrating technology within teaching and learning mathematics. Proper use of technology would help teachers and students to investigate more about mathematical ideasand it greatly influences on whatmathematics is being taught and what is being learned by students. For instance, the new technology application such as GeoGebra are becoming more useful to enhance teaching and learning mathematics to visualize mathematical concepts. However, student's access to this technology is dependent on teacher's uptake. The teacher plays a critical role in determining how this technology is used (McCulloch et al., 2018).

Geometric transformation is one of the topics in the mathematics syllabus in Malaysia. This topic is an important component in the field of geometry which requires the application of many movements such astranslation, reflection, rotation, and isometry (Mukamba & Makamure, 2020).Geometry is visual in nature and is only understood with visualization skills and high power of imagination in finding multi-dimensional patterns and shapes. (Idris 2006, Effandi & Lee, 2012, Mwingirwa & Miheso-O'Connor, 2016). Thus, this concept is what makes geometry unique and challenging to learn and teach. Hence, teaching and learning geometry is may not be easy, there exist both opportunities and challenges to incorporate ICT software like GeoGebra. GeoGebra is a free online software application and was a mathematics flexible tool designed especially for studying geometry and algebra at all levels of learning (Abramovich, 2013; Hohenwarter, 2008; Hohenwarter & Preneir, 2007). In response to the needs and for the benefits of learners, the usability of this software has been recommended in Malaysian Mathematics Secondary School Standard Curriculum. However, GeoGebra not yet widely used in teaching mathematics (Arbain & Shukor, 2015).

In order for students to acquire the desired geometry knowledge and skills, teachers' geometry content knowledge incorporated with the ICT software such as GeoGebra is important in facilitating the student's construction knowledge (Sunzuma & Maharaj, 2019). Based on relevant research, GeoGebra offered positive influence towards better performance, enthusiasm, confidence, and encouragement. Students are expected to develop several competences for them to work effectively in this technology-driven education which relevant to the RI 4.0. Therefore, this study was conducted to examine the usability of GeoGebra among Mathematics Secondary School teachers as a tool to enhance the learning of Geometric Transformation.

2.Objective of The Study

- To get an overview profile of Mathematics Secondary School teachers involved in the study.
- To get teacher's response on student's mastery level in learning Geometric Transformation.
- To get teacher's response on the use of GeoGebra in teaching Geometric Transformation.
- To find out teacher's challenges of using GeoGebra in teaching Geometric Transformation

3.Method

The aim of this study was to investigates teachers' perspectives towards the eventual use of GeoGebra as a tool to enhance the learning of Geometric Transformation. This study was conducted at secondary school in a district of Northern Malaysia (Kedah). The target population was all the secondary school mathematics teachers in the study location. The stratified and simple random sampling procedure was employed, and the sample involved 98 teachers. This study incorporated both quantitative and qualitative approaches. While the questionnaire with closed ended questions constituted the quantitative aspect of the study, the open-ended questionnaire questions were used for the qualitative aspect. The questionnaire was divided into three parts: demography, perceptions on student's ability in learning geometry, and response towards usability of GeoGebra. The questionnaire was tested for reliability using Cronbach alpha and found to have an alpha of 0.86. Data analysis was performed descriptively and via thematic content analysis.

4.Result and Discussion

The result of this study was presented according to the approaches used for data collecting.

4.1 Demographic Profile of the Teachers

Table 1 shows the demographic data of the teachers involved in this study. The gender composition of the respondents was 21.4% male and 78.6% female. According to Statistics, the gender representative of Northern Malaysia (Kedah) was 29.5% male and 70.5% female. Thus, the distribution of the sample was reasonably representative. Regarding the educational background of the respondents, 55.1% had a degree in education majoring in mathematics. Only very few percentages of the respondents had Certificate and Postgraduate Diploma in Education. Most respondents who about 76.5% had more than 10 years of Mathematics teaching experience. Therefore, the teachers who participated in this study could be said to be sufficiently qualified to teach the topic by virtue of their levels of training. The sample contained 98 respondent included Principal (2%), Senior Assistant Teacher (2%), GKMP Chairman (9.2%), Excellent Teachers (4.1%), and Academic Teachers (82.7%). By understanding the demographic of respondents, it can give an idea of whether the background of individual may influence the use of GeoGebra or not.

Table.1. DemographicProfile of the Teachers

Variables	Frequency	Percentage (%)
Gender		
Male	21	21.4
Female	77	78.6
Educational Background		
Certificate	4	4.1
Diploma	13	13.3
Degree	54	55.1
Postgraduate Diploma	6	6.1
Master	21	21.4
Mathematic Teaching Experience		
less than 10 years	23	23.5
10 years and above	75	76.5
Academic Position		
Principal	2	2
Senior Assistant Teacher	2	2
GKMP Chairman	9	9.2
Excellent Teacher	4	4.1
Academic Teacher	81	82.7

4.2 Teacher's response on student's mastery level in learning Geometric Transformation

The study benefited from the fact that the teachers sampled had many years of teaching experience. They not only had teaching skills developed over many years, but they also understood the challenge of teaching Geometric Transformation in secondary school and could identify the most difficult and poorly performed topics.Figure 1 shows the percentage of Teacher's response on student's mastery level in learning Geometric Transformation. In addition, it was found that 67.4% of the teachers were of the view that their student's mastery level in learning Geometric Transformation was at a moderate level. Only 8.2% were of the view that their students are at a good level and none of them thought that their students were at a very good level. Whereas 21.4% and 3.1% of teachers were in the view that their students were at a weak and strongly weak level respectively.

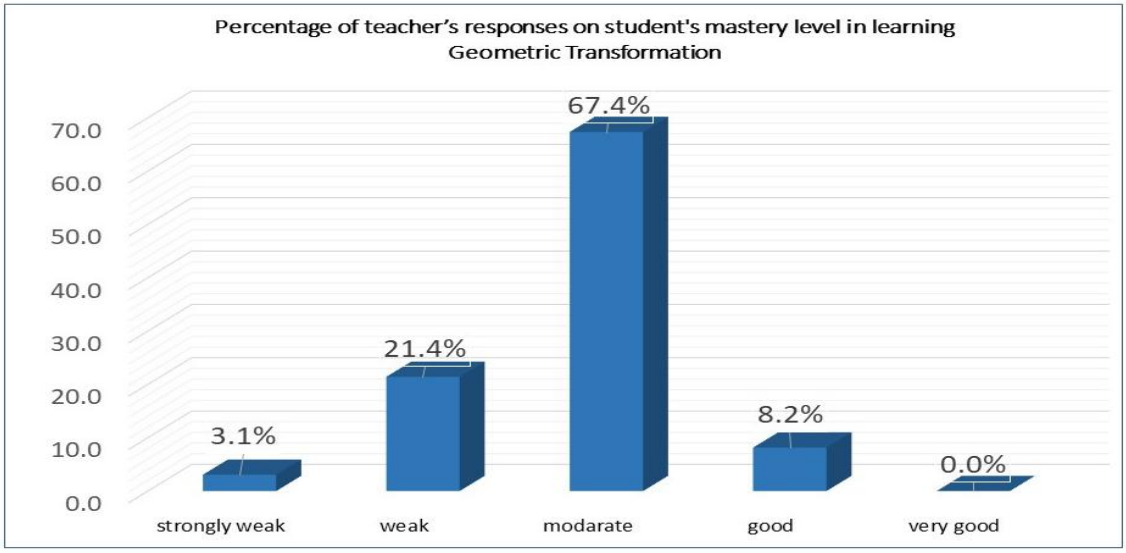

Figure.1. The percentage of Teacher's response on student's mastery level in learning Geometric Transformation.

Figure 2 shows teacher's perception on students' difficulty topic in learning Geometric Transformation. From the bar chart, the majority of teachers (83.7%) agreed that their students are difficult to understand rotation topics compared to others. It was important to establish teachers' level of technology uptake which was a recent development in the classroom. In addition, this gave both experienced and less experienced teachers a level exposition advantage.

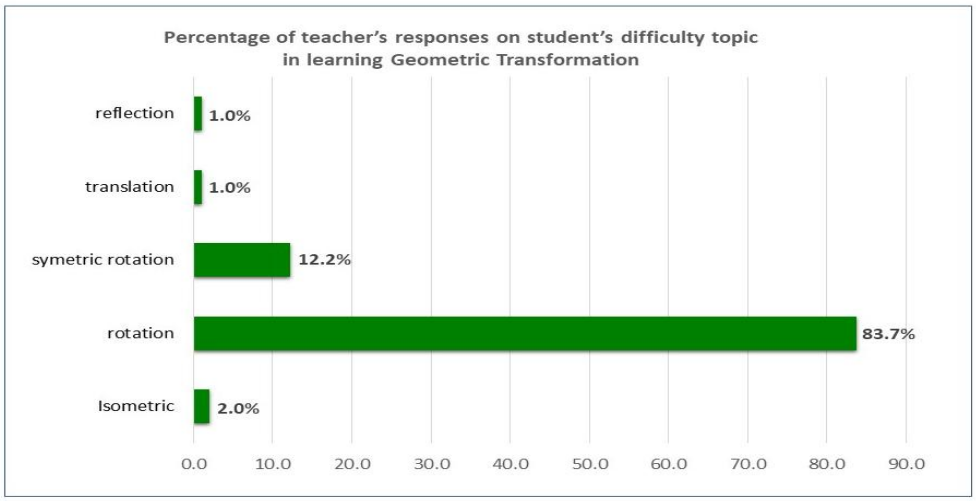

Figure. 2. Teacher's perception on students' difficulty topic in learning Geometric Transformation.

4.3 Teacher's response on the use of GeoGebra in teaching Geometric Transformation

The study sought to find out teacher'sperceptionon the use of GeoGebra in teaching Geometric Transformation in their classroom. The teachers were presented with five items to be chosen in which their commonly teaching approach used in teaching Geometric Transformation. Figure 3 shows the teacher's common teaching approach used in teaching Geometric Transformation. The information in Figure 3 reveals that only 15.3% teachers found to use GeoGebra in teaching Geometric Transformation. Most of them which around 83.7% prefer to use concrete material in their teaching. There are 38.8% of those who are more comfortable with the chalk and talk method, followed by 18.4% of teachers used power point and 12.2% used other methods in their teaching.

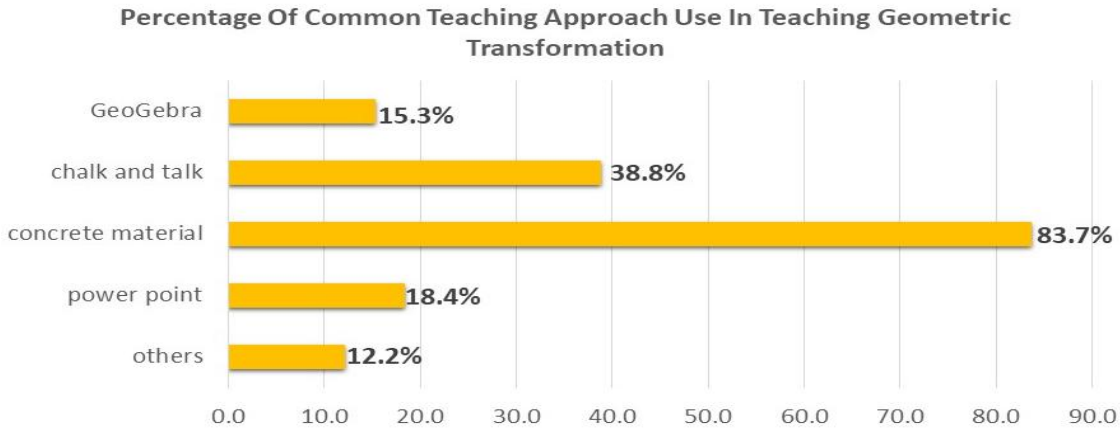

Figure. 3. Teacher's Common teaching approach use in teaching Geometric Transformation.

Regarding the frequency use of GeoGebra in a week, Figure 4 shows that 65% of those who used GeoGebra only used once in a week. Twenty nine percent of them used GeoGebra twice a week and a very small percentage of teachers (6%) used three to not more than four times in a week.

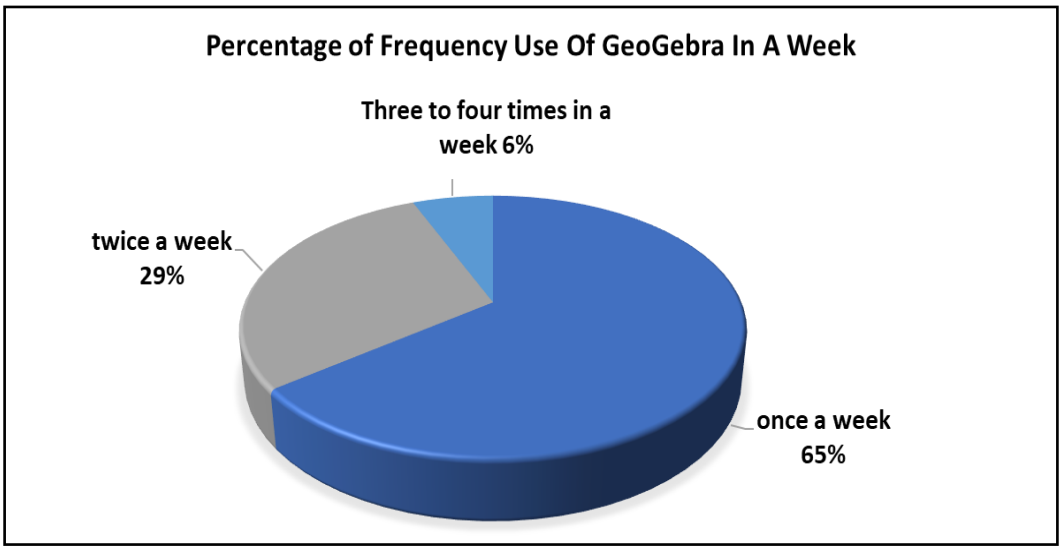

Figure. 4. Percentage of Frequency use of GeoGebra in a week.

Although the usage of GeoGebra has been recommended by the Malaysian Mathematics Curriculum and provided in textbooks, the result reveals that the GeoGebra usability among teachers were at the lower level. Thus, further investigation on this reason is needed to examine why teachers were less use GeoGebra in their teaching.

4.4 Teacher's challenges of using GeoGebra in teaching Geometric Transformation

Based on teachers written comments, majority of teachers agreed that GeoGebra useful in tackling various aspects of geometry. They are also aware that there was recommendation by Malaysian Mathematics Curriculum for the use of GeoGebra and yet, there was very little guideline in the textbooks. In average, teachers claim that they are not refusing to use this software, but they have so many constraints especially time constraint as they are tied to a heavy syllabus, and they involved with others administrative work. In fact, even they had attended a training, teachers also claim that they still feel hard to use GeoGebra in their classroom. It is due to the accessibility of resources-computers, student class ratio, and lack of competency in operating GeoGebra.Moreover, GeoGebra supplemented lessons requires belief of its users, a proper plan as well as thecareful implementation of sessions. Whiledelivering GeoGebra integrated lessons, care must be given in decidingthe role of the teacher, the choice of the lesson, and the design of the activities. As one can't fit for all, the choice ofappropriate topics and preparation of corresponding teaching materials is on teachers' hand. With that, teachers claim that the nee a lot of time in exploring GeoGebra and preparing the material for their teaching. As a result, this may becomeotherchallenges to deliver effective teaching Geometric Transformation using GeoGebra.

Furthermore, the teachers were asked to note their opinion and suggestion in overcoming this issue. Believing that GeoGebra has the potential to improve student's ability to grasp concepts in geometry that they have difficulty understanding, most of teacher agreed the need of developing a comprehensive module. This module can be a guide and would help them preparing materials as well as saving their time and would encourage more teachers to use GeoGebra in their teaching. Perhaps, this module could come together with the training

programs that adequately provide teachers to use GeoGebra to teach effectively in Geometric Transformation.

Although some teachers failed to use GeoGebra due to some obstacle that were not in their control, such as accessibility of resources-computers and student class ratio, these findings give an overview uptake of GeoGebra used among the secondary school mathematics teachers in the study location. It was observed that there were some teachers who were willing to use this software but were not able to, due to their low competency in operating GeoGebra. These finding are in line with the research finding conducted by Wassie and Zergaw (2018), McCulloch et al. (2018), Sunzuma & Manhaj (2019), Mukamba & Makamure (2020).

5. Conclusions

This study investigates teachers' perspectives towards the eventual use of GeoGebra as a tool to enhance the learning of Geometric Transformation. The study findings showed that the usability of GeoGebra among teachers at secondary school in a district of Northern Malaysia (Kedah) was at a lower level. This is due to some challenges that teachers face in teaching Geometric Transformation. These challengesincludee lack of competency, exposure, and experience in operating GeoGebra, facilities, and times constraints. It is recommended that module development and training programs should adequately provide teachers to use GeoGebra to teach effectively in Geometric Transformation.Anintelligent choice of GeoGebra enhanced lessons and designof activities has the advantages to inspire students toward their learning and hence to improve their academicachievement.

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