ASM Sc. J., 18, 2023

https://doi.org/10.32802/asmscj.2023.1044

The Nature of Gender Difference in The Effectiveness of GeoGebra

Z.Z. Mazlan[1] and H. Zulnaidi[2*]

[1]*Sekolah Kebangsaan Desa Pandan, 55100, Kuala Lumpur, Malaysia*

[2]*Department of Mathematics and Science Education, Faculty of Education Universiti Malaya, 50603, Kuala Lumpur, Malaysia*

GeoGebra is a type of Dynamic Geometric Software (DGS) that has been widely used to teach Mathematics. A substantial research study was done to investigate the effectiveness of GeoGebra to enhance students' learning in mathematics from varied dimensions. In this research, a systematic review of the effectiveness of GeoGebra to enhance students' learning in mathematics from varied dimensions was conducted using PRISMA's procedure. The use of GeoGebra as one of STEM education instrument has yet to be discovered. Thus, the further study of its effectiveness is needed. 11 articles between 2011-2020 have been analysed. The distribution of the accessed articles over the years were up and down by heading to its declining trend from 2011 to 2020. The distribution of origin in the accessed articles by country of origin shows that Asia dominated this study with six articles (55%), while Africa with three articles (27%) and North America and Europe, respectively produced one paper (9%). All accessed articles conclusively stated that GeoGebra can improve students and pupils cognitive and affective dimensions. In terms of gender difference, the conclusive findings show no gender difference on the effectiveness of GeoGebra in the teaching and learning of mathematics.

Keywords: Dynamic Geometric Software (DGS); GeoGebra; gender difference

I. INTRODUCTION

Many previous studies revealed that the use of technology is effective to enhance students' learning in mathematics from varied dimensions (Meng & Sam, 2013; Mazlan, 2020). Thus, this increasing consensus among mathematics educators and mathematicians that technology is becoming an integral part of mathematics teaching and learning (Lavicza *et al.*, 2020), promoting the use of technology in the classroom does give positive impact in constructing students' knowledge and understanding (Thambi & Eu, 2013). However, Daphne Bovelier, a Neuroscientist from University of Geneva, raised her concern about this trend. In an interview with DW Documentary for a documentary entitled *Smartphones, computers, and consoles – children and digital media*, she stated that "...this is a very young literature", referring to the effect of technology on children. She added, "...let me give you little perspective, it takes about twenty years to establish an effect in science. Tablets and the facts that has being used by very young children is at most seven years old. We are doing it commercially before we have actually done the science. I would much rather we do the science first and then we say whether it is safe or not". Since GeoGebra was first being commercialised in 2002 by Markus Hohenwater at the University of Salzburg, 2022 marked the 20 years of this Dynamic Geometry Software (DGS) has gone through some sort of period. Thus, this paper intended to review and to understand the science of this technology whether it is suitable to be used among children and beyond.

*Corresponding author's e-mail: hutkemri@um.edu.my

A. The Rise of GeoGebra

As for technology is Mathematics education, GeoGebra was always dominant as this DGS can be used in the classroom to assist learners and teachers in learning and teaching for the topic of geometry, algebra, and many other topics (Mazlan, 2019).

GeoGebra has first take off commercially and being used in education field since 2002. This, according to Bovelier (DW Documentary, 2021) has shown that GeoGebra has reached its mature period as many studies has been conducted to study its effect on the learners. However, the nature of gender difference has yet to come to conclusion. Up until now, this DGS has 100 million+ users, 153 GeoGebra Institutes and 1 million+ shared examples (Lavicza *et al.*, 2020). As GeoGebra is gaining popularity worldwide, a study to discern its nature of gender difference systematically is needed. This will provide a deeper and comprehensive data to the stakeholders worldwide, including Malaysia. Stakeholders can use these findings and make adjustment on their curriculum based on the nature of gender difference in applying GeoGebra within the classroom.

B. Gender Difference

Gender and sex are two connotations that are likely to intertwined and misunderstood by many. Sex refers to biological difference between females and males while gender refers to the cultural differences expected by society or culture of men and women according to their sex (McLeod, 2014). According to Pam (2013), someone's sex does not change from birth, but their gender can change. Thus, gender difference is typically the difference between men and women (Pam, 2013).

The gender leader in geometry is always changing throughout the years and throughout pupils' development age. Literature gathered shows that there is convincing evidence of no significant relationship between gender and achievement in number and numeration (Hutchison *et al.*, 2018), and algebraic processes and statistics (Odok, 2006). While some other researchers found the existence of tenuous relationship in geometry, favouring on male pupils (Ma, 1995; Neuschmidt *et al.*, 2008). TIMSS 2015 shows that female outperformed male in geometry with slight difference among Malaysian 8 graders (Mullis *et al.*, 2015) while in the latest cycle of TIMSS 2019, male outperformed female with enormous difference (Mullis *et al.*, 2020). The changing shift of the gender-lead in geometry based on the TIMSS reports should be taken into consideration and further study is needed to be conducted. This paper is trying to comprehend the nature of gender difference in the effectiveness of GeoGebra to enhance students' learning in mathematics from varied dimensions.

C. Objectives of The Review

The main purpose of this study is to discern the nature of gender difference in the effectiveness of GeoGebra to enhance students' learning in mathematics from varied dimensions. Under this general aim, the answers are searched for the following research question (RQ):

RQ1: How are the articles distributed over the years?

RQ2: What is the distribution of origin in the articles by country (and territory) of origin the study being conducted?

RQ3: What are the types of samples participated on the studies examined?

RQ4: What is the effectiveness of GeoGebra and the nature of gender difference?

II. METHOD – THE PRISMA PROCEDURE

The paper has used Preferred Reporting Items of Systematic Reviews and Meta-Analysis or PRISMA procedure adapted from Moher *et al.* (2009). Preferred Reporting Items of Systematic reviews and Meta-Analysis (PRISMA) statement was developed in 2005 which consist of four steps, namely, identification, screening, eligibility, and inclusion criteria. PRISMA can also be used as the foundation for reporting systematic review and benefits various fields (Moher *et al.*, 2009). This procedure consists of four stages which involved identification, screening, eligibility, and inclusion. This systematic review attempts to collate all empirical evidence that fits pre-specific eligibility criteria to answer a specific research question. PRISMA uses explicit, systematic methods that are selected with a view to minimise bias, thus provide reliable findings from conclusion can be drawn and

decisions made (Antman *et al.*, 1992; Oxman & Guyatt, 1993).

A. Limitations of Study

This research is limited to the selected articles in Google Scholar, Scopus, Web of Science (WoS), and ResearchGate. For the Scopus and WoS databases, access was used via Universiti Malaya database. Thus, this study only utilised these databases to provide a complete and systematic article searching procedure and analysis. Only accessed journals using English, Malay, and Indonesian languages being used.

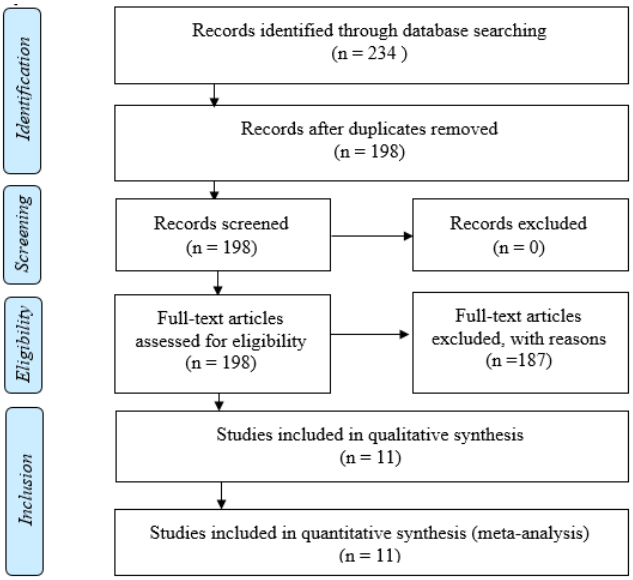

Figure 1. PRISMA's flow map.

Source: Adapted from Moher et al. (2009)

1. Identification

Titles and abstracts of 234 articles were filtered by the authors after the inclusion and exclusion process which was automatically completed using a database system (Table 1). The last search was run on 25 April 2021. Thus, 198 articles were selected to be read in full text. The authors read the full text of all articles.

Table 1. The search strings.

Database	Search String
Google Scholar/ Scopus/ Web of Science/ Mendeley	all AND geogebra AND effect OR enhancing AND learner OR students OR pupils OR children AND achievement OR understanding OR skill OR misconception OR ability OR knowledge AND gender AND comparison OR gender AND difference OR male OR female OR boy OR girl

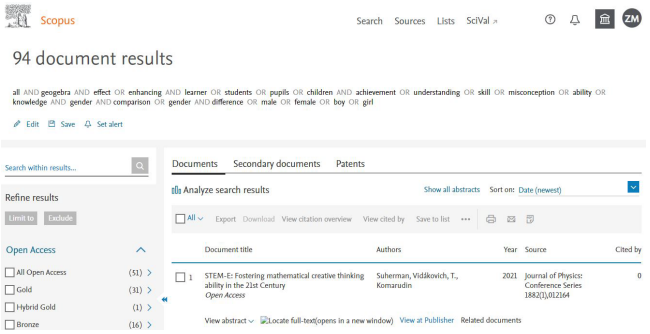

Figure 2. Advanced menu to enter search string on Scopus

Note. The clipping was taken from a website for Scopus (https://www.scopus.com/home.uri).

2. Screening

The following search terms to search all studies in the related topic: GeoGebra; effect; enhancing; learner; students; pupils; children; achievement; motivation; attitude; belief; understanding; skill; ability; knowledge; misconception; gender difference; gender comparison; male; female; boy; girl. From 234 articles, only 198 articles were selected after the screening process. 36 records being excluded due to systematic review articles, book series, chapter in book and book.

3. Eligibility

Eligibility assessment was performed independently in an unblinded standardised manner by two reviewers. From 198 articles, only 11 articles were included in the third step. 187 articles being excluded with reasons as such do not comply with the objective of the review. Any articles that do not involved the effect of GeoGebra on teaching and learning will be excluded.

4. Inclusion

11 articles have been chosen after eligibility assessment and authors examine the articles and found out the following results. The 11 articles are as follow;

Table 2. List of the accessed studies.

Author(s)	Title
Klemer & Rapoport (2020)	Origami and GeoGebra Activities Contribute to Geometric Thinking in Second Graders
Lestari *et al.* (2019)	The Effect of Reciprocal Peer Tutoring Strategy Assisted by GeoGebra on Students' Mathematical Communication Ability Reviewed from Gender
Seloraji & Eu (2017)	Students' Performance in Geometrical Reflection Using GeoGebra
Onaifoh & Ekwueme (2017)	Innovative Strategies on Teaching Plane Geometry using GeoGebra Software in Secondary Schools in Delta State
Emaikwu *et al.* (2015)	Effect of GeoGebra on Senior Secondary School Students' Interest and Achievement in Statistics in Makurdi Local Government Area of Benue State, Nigeria
Vasquez (2015)	Enhancing Student Achievement using GeoGebra in a technology Rich Environment
Shahmohammadi & Kamalludeen (2014)	Teachers' Intention to Use GeoGebra in Teaching Mathematics in Malaysia
Hutkemri & Zakaria (2012)	The Effect of GeoGebra on Students' Conceptual and Procedural Knowledge of Function
Mukiri (2012)	Feasibility of using GeoGebra in the teaching and learning of geometry concepts in secondary schools in Kajiado County, Kenya
Doğan & Içel (2011)	The role of dynamic geometry software in the process of learning: GeoGebra example about triangles
Lee (2011)	Using GeoGebra to enhance learning and teaching of basic properties of circles for a secondary 5 class

III. RESULT AND DISCUSSION

In this study, PRISMA has be utilised to discern the nature of gender difference on the effectiveness of GeoGebra to enhance learners' learning in mathematics from varied dimensions. A total of 11 scientific research papers being discussed and categorised into cognitive and affective dimensions which are cognitive dimension (Doğan & Içel, 2011; Hutkemri & Zakaria, 2012; Klemer & Rapoport, 2020; Lestari *et al.,* 2019; Mukiri, 2012; Onaifoh & Ekwueme, 2017; Seloraji & Eu, 2017) and affective dimension (Emaikwu *et al.*, 2015; Lee, 2011; Shahmohammadi & Kamalludeen, 2014; Vasquez, 2015).

A. RQ1: How are the articles distributed over the years?

Even though GeoGebra has been commercialised since 2002 (Lavicza *et al.*, 2020), the studies of gender difference on the effectiveness of GeoGebra to enhance learners' learning in mathematics from varied dimensions only set its first foot in 2011, ten years after it commercialised. The studies in regards of GeoGebra has already employed since its first started off, Mazlan (2019) stated that the studies of GeoGebra can be categorised into four themes which include: (a) The effect of using GeoGebra, (b) Intention to use GeoGebra, (c) Example of integrating GeoGebra in teaching and learning, and (d) Development of module based GeoGebra.

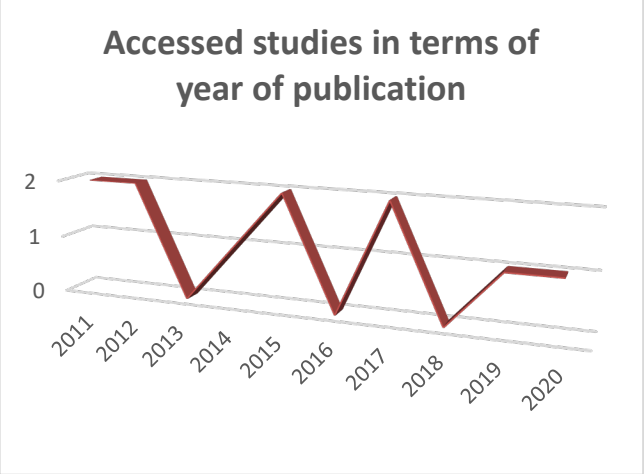

Figure 3. Distribution of the accessed studies in terms of year of publication.

The studies on the effectiveness of GeoGebra in the teaching and learning of mathematics has started since it was first commercialised, yet the studies on gender difference on this effectiveness has yet to be discerned. This study utilised collated studies to comprehend the conclusive trend of gender difference of the effectiveness of GeoGebra in the teaching and learning of mathematics. Based on Figure 4, from 2011 to 2020, the number of articles published in regards of the related topic keep decreasing. Two articles published respectively in 2011, 2012, 2015, and 2017 (Doğan & Içel, 2011; Hutkemri & Zakaria, 2012; Lee, 2011; Mukiri, 2012; Onaifoh & Ekwueme, 2017; Seloraji & Eu, 2017), one article published respectively in 2019 and 2020 (Klemer & Rapoport, 2020; Lestari *et al.*, 2019), while no article being published in 2013, 2016 and 2018. This is contradict with the review from Mazlan (2019) stating that the period of 2012 to 2014 and 2016 to 2018 show the highest peak of publication in regards of the study of GeoGebra in Malaysia. Mazlan and Abd Hamid (2020) on the other hand, in their review found that 2013 to 2017 shows the researchers are getting interested to study the effect of integrating GeoGebra on students' images of mathematics. These two reviews are showing different and quite contradict finding but bare in mind that the focus of each review are different. Thus, the 'no article' published related to the gender difference on the effectiveness of GeoGebra in learning mathematics shows that researchers are not interested to study the effectiveness of GeoGebra in learning mathematics from gender difference perspective noting that this is a research topic that could be pick up by future researchers.

B. RQ2: What is the distribution of origin in the articles by country (and territory) of which the study being conducted?

By examine the distribution of the location where the studies being conducted, it enables us to understand the popularity of gender difference in GeoGebra studies among diverse countries. As demonstrated in Figure 2, Indonesia, Malaysia, and Nigeria, respectively have two studies (n = 6; 54.5%) (Emaikwu *et al.*,2015; Hutkemri & Zakaria, 2012; Lestari *et al.*, 2019; Onaifoh & Ekwueme, 2017; Seloraji & Eu, 2017; Shahmohammadi & Kamalludeen, 2014). Other studies were conducted in Hong Kong, Israel, Kenya, Turkey, and United States of America (n = 5; 45.5%) (Doğan & Içel, 2011; Klemer & Rapoport, 2020; Lee, 2011; Mukiri, 2012; Vasquez, 2015).

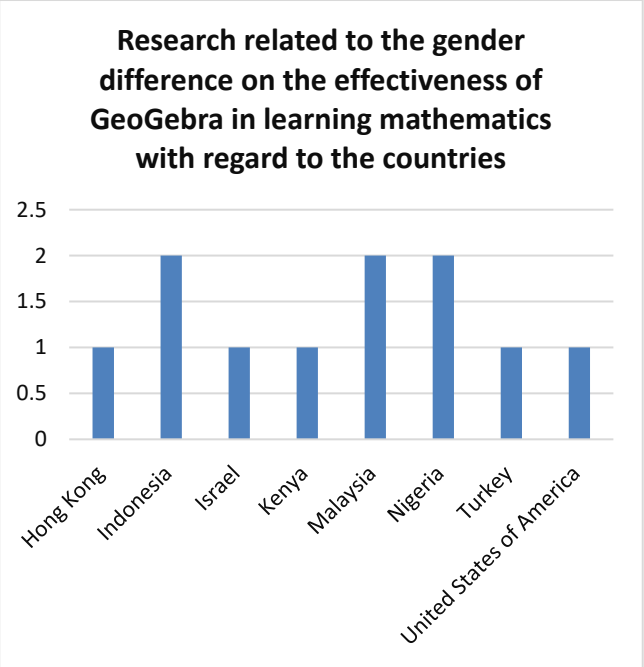

Figure 4. Distribution of country in the articles by country (and territory) of which the study being conducted.

Since all selected articles are written either in English, Malay or Indonesian languages, some other relevant papers are undiscoverable because of language barrier. There might be some other articles that discussed the topic of gender difference on the effectiveness of GeoGebra in the teaching and learning of mathematics. From Figure 2, Asia

dominated this study with six articles (55%), while Africa with three articles (27%) and North America and Europe, respectively produced one paper (9%). The finding shows that GeoGebra is quite popular to be used in education system in Asia compared to other regions.

C. RQ3: What are the types of samples participated on the studies examined?

When empirical studies were considered in terms of their samples, it was revealed that a large body of them (64%) were conducted on secondary school students (Emaikwu *et al.*, 2015; Hutkemri & Zakaria, 2012; Lee, 2011; Lestari *et al.*, 2019; Mukiri, 2012; Onaifoh & Ekwueme, 2017; Shahmohammadi & Kamalludeen, 2014; Vasquez, 2015). On the flip side, (27%) of the studies were conducted on primary school pupils (Doğan & Içel, 2011; Klemer & Rapoport, 2020; Seloraji & Eu, 2017). While only one study being carried out among teacher, namely secondary school teachers (9%) in which they were taught to used GeoGebra in teaching mathematics.

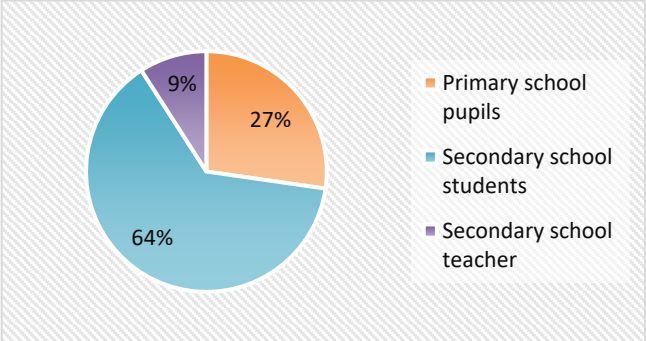

Figure 5. Distribution of accessed articles in terms of samples.

The collated finding is coherent with Lavicza *et al.* (2020), GeoGebra was mainly being introduced to be used for secondary students. As the Mathematics curriculum all around the world are revamping their curriculum, new topics being introduced at lower level of education (Mazlan, 2020; Mazlan *et al.*, 2019). Thus, the use of GeoGebra is gaining popularity and significant at primary level of education. GeoGebra is dynamic and keep updating its features and feasibility to accommodate the current trend such as commands starting from the slope of a straight line up to differentiation and integration of function (Hohenwater & Fuchs, 2004). It has gone mobile (Ancsin *et al.*, 2011) and gone web (Ancsin, 2013). With 100 million+ users, 153 GeoGebra Institutes and 1 million+ shared examples (Lavicza *et al.*, 2020), no wonder this DGS is gaining popularity as it can suite and accommodate with the revamping of curriculum that is happening all over the world especially at lower level of education.

D. RQ4: What is the effectiveness of GeoGebra and the nature of gender difference?

Table 3. Distribution of the effectiveness of GeoGebra and the nature of gender difference.

Author(s)	The effectiveness of GeoGebra	The nature of gender difference.
Klemer & Rapoport (2020)	Pupils' geometric knowledge gap between low and high achieving pupils was eliminated.	No gender difference.
Lestari *et al.* (2019)	GeoGebra affects students' mathematical communication ability significantly.	No gender difference.
Seloraji & Eu (2017)	Positive effect by teaching reflection topic using GeoGebra Software on students' performance in mathematics lessons.	Girls did better than boys.
Onaifoh & Ekwueme (2017)	GeoGebra method of teaching plane geometry enhances students' performance in plane geometry and motivates their interest in learning of plane geometry.	No gender difference.
Emaikwu *et al.* (2015)	Students taught statistics using the GeoGebra teaching method achieved higher and showed greater interest in learning statistics than those taught with conventional teaching approach.	No gender difference.
Vasquez (2015)	GeoGebra increased students' motivation and engagement in learning geometric transformations. Students in the treatment group were actively involved in their discovery learning moving sliders,	Favouring boys.

	translating, rotating, and reflecting figures on GeoGebra.	
Shahmohammadi & Kamalludeen (2014)	Positive relationship between intention to use with perceived usefulness, perceived ease of ease, and perceived current competencies.	No gender difference.
Hutkemri & Zakaria (2012)	The use of GeoGebra in the teaching and learning process contributes to the enhancement of students' conceptual and procedural knowledge on the topic of function.	No gender difference.
Mukiri (2012)	GeoGebra would help improve the students' understanding of concepts in mathematics and hence improve performance.	No gender difference.
Doğan & Içel (2011)	Computer-based classroom activities by using GeoGebra can achieve high-level of thinking that leads to geometric construction skill.	No gender difference.
Lee (2011)	Boys have positive perception towards the use of computer by using GeoGebra in learning basic properties of circles.	Favoring boys.

Table 2 shows conclusive findings, out of 11 articles, eight articles show no gender difference on the effectiveness of GeoGebra in the teaching and learning of mathematics (Doğan & Içel, 2011; Emaikwu *et al.*, 2015; Hutkemri & Zakaria, 2021; Klemer & Rapoport, 2020; Lestari *et al.*, 2019; Mukiri, 2012; Onaifoh & Ekwueme, 2017; Shahmohammadi & Kamalludeen, 2014), two articles show that male learners did better than female in learning mathematics by using GeoGebra (Lee, 2011; Vasquez, 2015) while only one shows the other side (Seloraji & Eu, 2017). The difference in gender differences between male and female was due to the human physical and psychological development (Nazila *et al.*, 2019) while some scholars stating that the treatment and attention given by the teachers (Yuniarti, 2014), contributed to this result. Majority of the accessed articles show that there is no gender difference on the effectiveness of GeoGebra in teaching and learning in mathematics. This can be seen on the trend shown from the collated data. Thus, human physical and psychological development are not being seen as giving impact to this study.

IV. CONCLUSION

PRISMA has been used to discern the nature of gender difference in the effectiveness of GeoGebra in teaching and learning of mathematics from varied dimensions. Four research questions have been deployed to support the general aim of this study. The distribution of the accessed articles over the years were up and down by heading to its declining trend. Based on Figure 3, from 2011 to 2020, the number of articles published in regards of the related topic keep decreasing. Two articles published respectively in 2011, 2012, 2015, and 2017 (Doğan & Içel, 2011; Hutkemri & Zakaria, 2012; Lee, 2011; Mukiri, 2012; Onaifoh & Ekwueme, 2017; Seloraji & Eu, 2017), one article published respectively in 2019 and 2020 (Klemer & Rapoport, 2020; Lestari *et al.*, 2019), while no article being published in 2013, 2016 and 2018.

The distribution of origin in the accessed articles by country (and territory) of origin the study being conducted shows that Asia dominated this study with six articles (55%), while Africa with three articles (27%) and North America and Europe, respectively produced one paper (9%). As for the types of samples participated on the studies examined, most of the accessed articles conducted their studies on secondary students (64%) following by primary pupils (27%) while 9% on school teachers. The collated finding is coherent with Lavicza *et al.* (2020), GeoGebra was mainly being introduced to be used for secondary students. As the Mathematics curriculum all around the world are revamping their curriculum, new topics being introduced at lower level of education (Mazlan, 2020; Mazlan *et al.*, 2019).

As for the effectiveness of GeoGebra in teaching and learning of mathematics, all accessed articles conclusively stated that GeoGebra can improve students and pupils cognitive and affective dimensions. Six articles provide significant evidence that by using GeoGebra, learners'

achievement can be enhanced from their geometric knowledge (Klemer & Rapoport, 2020), conceptual and procedural knowledge (Hutkemri & Zakaria, 2012), achievement in reflection topic (Seloraji & Eu, 2017), plane geometry (Onaifoh & Ekwueme, 2017), geometric transformation (Vasquez, 2015), and topic of function (Hutkemri & Zakaria, 2012). Other than cognitive domain, effective domain also affected positively using GeoGebra where learners' motivation (Emaikwu *et al.*, 2015; Vasquez, 2015) and perception (Lee, 2011; Shahmohammadi & Kamalludeen, 2014) in learning mathematics have increased.

In term of gender difference, the conclusive findings show no gender difference on the effectiveness of GeoGebra in the teaching and learning of mathematics. The difference in gender differences between male and female was due to the human physical and psychological development (Nazila *et al.*, 2019) while some scholars stating that the treatment and attention given by the teachers (Yuniarti, 2014), contributed to this result. This can be seen on the trend shown from the collated data, Seloraji and Eu (2017) found that girls performed better than girls stating that the sample was seven years old pupils while studies from Lee (2011) and Vasquez (2015) stating that boys performed better than girls stating that the sample was 14 to 17 years old. However, this gender difference does not reflect the effect of GeoGebra in teaching and learning as a whole. Majority of the accessed articles show that there is no gender difference on the effectiveness of GeoGebra in teaching and learning in mathematics. Thus, human physical and psychological development are not being seen as giving impact to this study.

Due to the limitation of languages, and database chosen, it is suggested that further studies to be conducted to cover other languages and databases. This study also signifies correct direction for future research to continue digging up the nature of gender difference of the effectiveness of GeoGebra to enhance teaching and learning in mathematics from varied dimensions.

V. ACKNOWLEDGEMENT

We would like to thank the esteemed colleagues and members of the public who contributed to this paper, as well as the paper's anonymous reviewers for their acknowledgeable comments.

VI. REFERENCES

Ancsin, G, Hohenwater, M & Kovacs, Z 2011, 'GeoGebra goes Mobile' The Electronic Journal of Mathematics and Technology, vol. 1, no. 1, pp. 1-10.

Ancsin, G, Hohenwater, M & Kovacs, Z 2013, 'GeoGebra goes Web' The Electronic Journal of Mathematics and Technology, vol. 7, no. 6, pp. 412-418.

Antman, E, Lau, J, Kupelnick, B, Mosteller, F & Chalmers, T 1992, 'A comparison of results of meta-analyses of randomized control trials and recommendations of clinical experts' JAMA, no. 268, pp. 240-248.

Doğan, M & Içel, R 2011, 'The role of dynamic geometry software in the process of learning: GeoGebra example about triangles' International Journal of Human Sciences, vol. 8, no.1, pp. 1441-1457.

DW Documentary 2021, 'Smartphones, Computers, and Consoles - Children and digital media', viewed 16 February 2022, <https://www.youtube.com/watch?V=ywDwDaEoVvo>.

Emaikwu, S, Iji, CO & Abari, MT 2015, 'Effect of GeoGebra on Senior Secondary School Students' Interest and Achievement in Statistics in Makurdi Local Government Area of Benue State, Nigeria' IOSR Journal of Mathematics, vol. 11, no. 3, pp. 14-21. doi:10.9790/5728-11341421.

Hohenwater, M & Fuchs, K 2004, 'Combination of dynamic geometry, algebra, and calculus in the software system GeoGebra', ZDM, pp. 1-6.

Hutchison, JE, Lyons, IM & Ansari, D 2018, 'More Similar Than Different: Gender Differences in Children's Basic Numerical Skills Are the Exception Not the Rule', Child Development, pp. 66 - 79. doi: 10.1111/cdev.13044.

Hutkemri, Z & Zakaria, E 2012, 'The Effect of GeoGebra on Students' Conceptual and Procedural Knowledge of Function', Indian Journal of Science and Technology, vol. 5, no. 12, pp. 3802-3808.

Klemer, A & Rapoport, S 2020, 'Origami and GeoGebra Activities Contribute to Geometric Thinking in Second

Graders', EURASIA Journal of Mathematics, Science, and Technology Education, vol. 16, no. 1, pp. 1 - 12. doi: 10.29333/ejmste/8537.

Lavicza, Z, Prodromou, T, Fenyvesi, K, Hohenwater, M, Juhos, I, Koren, B & Diego-Mantecon, J 2020, 'Integrating STEM-related technologies into mathematics education at a large scale', International Journal for Technology in Mathematics Education, vol. 27, no. 1, pp. 3-11.

Lee, C-h 2011, 'Using GeoGebra to enhance learning and teaching of basic properties of circles for a secondary 5 class', Master's thesis, University of Hong Kong.

Lestari, L, Mulyono & Syafari 2019, 'The Effect of Reciprocal Peer Tutoring Strategy Assisted by GeoGebra on Students' Mathematical Communication Ability Reviewed from Gender', Education Quarterly Reviews, vol. 2, no. 2, pp. 292-298. Doi:10.31014/aior.1993.02.02.61.

Ma, X 1995,'Gender differences in mathematics achievement between Canadian and Asian education systems', The Journal of Educational Research, no. 89, pp. 118-127.

Mazlan, ZZ 2019, 'Reviewing Studies on GeoGebra usage in Primary Education within Malaysian Context', in Proceeding of Seminar Penyelidikan Pendidikan dan Amalan Terbaik PdP Peringkat Kebangsaan (SAHConfEd 2019), 16-17 Oct 2019, Institut Pendidikan Guru Kampus Sultan Abdul Halim, Sungai Petani, Kedah.

Mazlan, ZZ, Meng, CC & Abd. Hamid, MF 2019, 'Achievement of Dual Language Learners in The Study of Nets', North American GeoGebra Journal, vol. 8, no.1, pp. 69-93.

Mazlan, ZZ 2020, 'Analyzing Year 2 DLP Pupils' Motivation in Learning The Topic of Shape and Space by Using ARCS Model Instruction Incorporating GeoGebra', Jurnal Penyelidikan Pendidikan Guru, no. 15, pp. 1-16.

McLeod, S 2014, 'Biological Theories of Gender', Retrieved from Simply Psychology, viewed 2 March 2022, <https://www.simplypsychology.org/gender-biology.html>.

Meng, CC & Sam, LC 2013, 'Enhancing Primary Pupils' Geometric Thinking through Phase-Base Instruction Using the Geometer's Sketchpad', Asia Pacific Journal of Educators and Education, vol. 28, pp. 33-51.

Moher D, Liberati, A, Tetzlaff, J, & Altman, D 2009, 'Preferred Reporting Items for Systematic Review and Meta-Analyses: The PRISMA Statement', PLoS Med, vol. 6, no. 7. doi:10.1371/journal_pmed1000097.

Mukiri, MI 2016, 'Feasibility of using GeoGebra in the teaching and learning of geometry concepts in secondary schools in Kajiado County', PhD thesis, Kenyatta University, Kenya.

Mullis, IV, Martin, MO, Foy, P & Hooper, M 2015, TIMSS 2015 International Results in Mathematics, IEA: TIMSS & PIRLS International Study Center, Boston College, Lynch School of Education, Massachusetts.

Mullis, IV, Martin, MO, Foy, P, Kelly, DL & Fishbein, B 2020, TIMSS 2019 International Results in Mathematics and Science, Chesnut Hill, MA: Boston College.

Nazila, L, Rosidin, U, Distrik, W, Herlina, K & Hasnunidah, N 2019, 'The Effect of Applying Argument Driven Inquiry Models to the Critical Thinking Skills of Students Based on Gender Differences', Scientiae Educatia: Jurnal Pendidikan Sains, vol. 8, no. 1, pp. 36-50. doi: 10.24235/sc.educatia.v8i1.4145.

Neuschmidt, O, Barth, J & Hastedt, D 2008, 'Trends in gender differences in mathematics and science', Studies in Educational Evaluation, no. 34, pp. 56-72.

Onaifoh, NM & Ekwueme, CO 2017, 'Innovative Strategies on Teaching Plane Geometry using GeoGebra Software in Secondary Schools in Delta State', Global Journal of Educational Research, no. 16, pp. 55-62. doi: 10.4314/gjedr.v16i1.8.

Oxman, A & Guyatt, G 1993, 'The science of reviewing research', Ann NY Acad Sci, no. 703, pp. 133-124.

Pam, NM 2013, Gender Differences. PsychologyDictionary.org, viewed 3 March 2022, <https://psychologydictionary.org/gender-differences/>.

Seloraji, P & Eu, LK 2017, 'Students' Performance in Geometrical Reflection Using GeoGebra', MOJET-Malaysian Online Journal of Educational Technology, vol. 5, no. 1, pp. 65-77.

Shahmohammadi, SB & Kamalludeen, R 2014, Teachers' Perception of using GeoGebra in Teaching Mathematics in Malaysia. Proceeding of Seminar Kebangsaan Majlis Dekan – Dekan Pendidikan IPTA 2014, 25-26 September 2014, Universiti Malaya, Kuala lumpur.

Thambi, N & Eu, LK 2013, 'Effects of students' Achievement in Fractions using GeoGebra', Sainsab, no. 16, pp. 97-106. doi:10.1016/j.sbspro.2015.01.356.

Vasquez, DE 2015, 'Enhancing Student Achievement using GeoGebra in a technology Rich Environment', Masters thesis, California State Polytechnic University, Pomona, CA.

Yuniarti, RD 2014, 'Pengaruh sikap dan gender terhadap prestasi belajar bahasa Indonesia pada siswa SMP Negeri kelas VII di Kecamatan Sleman Yogyakarta 2013/2014'

Bachelor Thesis, Universitas Negeri Yogyakarta, Indonesia.