CHAPTER 1

INTRODUCTION

This chapter introduces the background of the study, problems identifications, scopes, limitations, research questions, research objectives, significances of the study, and thesis overview.

1.1 Background of the Study

Mathematics has been an integral part of human experience since ancient times and some great nations, such as Egyptians, Babylonians, and Greeks have given great contributions to the mathematics developments (Burton 2011, as cited in Raikhola 2024, 92). The Egyptians found base-10 system in numeracy, while the Babylonians developed more advanced mathematics specialized in algebra and geometry (Raikhola 2024, 93). Grigoriadou (2023, 575) stated that Greeks inventors, like Archimedes and Euclid introduced a theoretical framework, focusing on the deductive reasoning and axiomatic method which later would be the foundation of contemporary mathematics. All the developments of those ancient mathematics have dynamically influenced contemporary mathematical learning in the current education system.

Learning mathematics is important for education, especially for students. There are various reasons for learning mathematics, such as boosting critical thinking, problem-solving skills, logical reasoning by integrating various fields in real life; for instance, science, economics, and even daily decision making (Kusumah et al. 2020, 896-898). Furthermore, Guntur and Setyaningrum (2021,

159) also add that mathematics can develop more structured ways of thinking for the students and can be beneficial for their future lives. By studying mathematics at school in accordance with the curriculum, the students can get a lot of benefits in the present and the future. Therefore, learning mathematics is beneficial for students to be ready in facing the upcoming obstacles in their lives.

As the reasons for learning mathematics emerge to the surface, the technology in this modern era has also developed rapidly. This technological development plays a crucial role in helping the students when they learn mathematics. Bright, Welcome, and Arthur (2024, 1) highlights that technology usage in learning mathematics could influence student performance positively since it can boost the interests of the students in mathematics. In accordance with the previous experts, Poçan, Altay, and Yaşaroğlu (2022, 683) also states that the integration of technology in mathematics can enhance not only student performance but also their motivation by facilitating a more interactive and engaging learning environment. Hence, the integration of technology in learning mathematics may bring positive effects, such as improving student performance and learning motivation.

Positive effects of using technology in learning mathematics may bring bright hope for helping the students in reaching their full potential in terms of performance and motivation. Among all the options in what technology educators shall use, GeoGebra comes up as a standout option to be chosen. There are some notable findings by the researchers about what GeoGebra could offer to the learning environments, particularly in learning mathematics. The first one, GeoGebra provides an interactive mathematical environment which allows students in

visualizing and manipulating mathematical concepts (Garba 2019, 29). Then, the second, research has shown that students' understanding of complex mathematical ideas, such as geometry and algebra, can be improved significantly because it provides dynamic visual representations (Ichtiari et al. 2024, 37). More findings by Birgin and Yazıcı (2021, 925) have also shown that GeoGebra can promote students' problem-solving skills even more. By the evidence found by the experts, it can be concluded that GeoGebra is a leading software which offers a lot of benefits for the students in learning mathematics by providing dynamic learning environments.

Despite all of the benefits and reasons behind learning mathematics, mathematics education faces tough challenges in serving its purposes to help students succeed in the future. The data from the Programme for International Student Assessment (PISA) display a struggle among Indonesian students when they learn mathematics. Hidayat et al. (2023, 3) shows that in the 2018 PISA assessment, Indonesian students were significantly below the PISA average mathematics score of 489 with the score of 379, placing Indonesia among the lowest rank (number 7 from the bottom rank). Moving forward, Indonesia had improved a few ranks into the rank of 69 out of 80 countries according to the 2022 PISA ranking; however, the mathematics proficiency tests result decreased into 366 from 379 in the previous PISA test results (OECD 2023). These data have shown that the real portrait of Indonesia in mathematics education is not good enough and still needs some improvements. The mathematics education is still far from the expectations about what mathematics should be in helping the students for their futures.

The low scores and ranks of the Indonesia in mathematics education are such an unpleasant fact to be faced by every Indonesian citizen, especially the

mathematics teachers. This unpleasant portrait of the Indonesian mathematics education can also be seen at XYZ School. Based on the initial gathered data, the average score of the mathematics proficiency test was 44.77 (See Appendix G). This score was not a good result because only 113 out of 654 students passed the expected learning outcome, which was 65, from the XYZ School. This result displays the low level of student academic performance in mathematics. This fact was supported by another initial finding after doing some observations in the classroom during the first two weeks of school which lasted from July 22, 2024 to August 2, 2024. From the conducted observations, some students in the classroom appeared not to be enthusiastic and showed a lack of learning motivation while they were studying mathematics.

From the previous explanations, the real condition in mathematics education has not met the ideal expectation in helping to shape the students' future lives. Therefore, this gap should be bridged, and the solutions must be found as soon as possible to achieve a significant goal in education. GeoGebra with all the benefits can be integrated into mathematics education to improve the student Academic Performance and Learning Motivation. As mathematics may be seen as individual type of subject, the grouping approach was proposed to help achieve the goal in improving those two qualifications of the students, particularly at XYZ School. This approach was implemented after the mathematics proficiency test in August 2024, which served as the basis for ability-based student grouping. Ultimately, a comprehensive understanding might be attained regarding whether the Between-Class Ability Grouping approach and the integration of GeoGebra could affect the student Academic Performance and Learning Motivation in mathematics.

1.2 Problem Identifications

In order to visualize more clearly and understand more whether GeoGebra and grouping approach could help improving student performance and learning motivation, some important problems had been identified and needed to be brought up and solved, which covered the following aspects:

1) The student Academic Performance reflected by their mathematics proficiency tests were particularly low with the average score was 44.77;
2) Only 17.28 % (113 out of 654) of the first-year students were able to reach the expected learning outcomes in mathematics proficiency tests;
3) Students' Learning Motivation were quite low in learning mathematics;
4) Mathematics was delivered using a monotonous teaching technique;
5) Mathematics education had to be reformed by using a more interactive teaching technique;
6) The development of technology has been so rapid that it can be utilized to support mathematics education;
7) Using technology in mathematics education could be a solution in helping the students to improve their Academic Performance and Learning Motivation;
8) GeoGebra could be introduced to help the students in learning mathematics better by providing an interactive and dynamic learning environment;
9) Between-Class Ability Grouping method could also be implemented in order to reform the mindset of mathematics as an individual subject.

1.3 Scope and Limitations

The scope and limitations of this study are listed as follows:

1) This study focused on the effects of Between-Class Ability Grouping on student Academic Performance and Learning Motivation;
2) Between-Class mathematics ability grouping acted as the independent variable, while the student Academic Performance and Learning Motivation acted as the dependent variables;
3) GeoGebra was used as moderating variable whether it could influence further on the effects of Between-Class Ability Grouping on student Academic Performance and Learning Motivation;
4) A quantitative research approach using a survey design was implemented and the collected data were processed using the descriptive statistics, the Pearson correlation and multiple regression analysis;
5) The data were collected and processed during the mathematics classes conducted between January–May 2025, including a set of data collected earlier, based on the school records;
6) The subjects of the study were the first-year students at the Senior High School XYZ Tangerang.

1.4 Research Questions

The research questions were formulated as follows:

1. What are the effects of the Between-Class Ability Grouping on the student Academic Performance?

2. What are the effects of the Between-Class Ability Grouping on the student Learning Motivation?
3. Are the student Academic Performance correlated with the student Learning Motivation?
4. To what extent does GeoGebra moderate the effects of the Between-Class Ability Grouping on the student Academic Performance?
5. To what extent does GeoGebra moderate the effects of the Between-Class Ability Grouping on the student Learning Motivation?

1.5 Research Objectives

The research was conducted in order:

1. To examine the effects of the Between-Class Ability Grouping on the student Academic Performance.
2. To examine the effects of the Between-Class Ability Grouping on the student Learning Motivation.
3. To analyse whether the student Academic Performance correlate with the student Learning Motivation.
4. To assess the moderating roles of GeoGebra in the effects of the Between-Class Ability Grouping on the student Academic Performance.
5. To assess the moderating roles of GeoGebra in the effects of the Between-Class Ability Grouping on the student Learning Motivation.

1.6 Significance of the Study

1.6.1 Theoretical Significance

The theoretical significance of the study is listed as follows:

1) Giving a theoretical understanding about the effectiveness of the Between-Class Ability Grouping on the Indonesian educational context;
2) Enriching the Between-Class Ability Grouping theory, especially by exploring its interactions with the Academic Performance and Learning Motivation;
3) Examining the roles of GeoGebra as a moderator in enhancing Academic Performance and Learning Motivation through the Between-Class Ability Grouping;
4) Building a strong theoretical foundation about integrating GeoGebra in mathematics.

1.6.2 Practical Significance

The practical significance of the study is listed as follows:

1) Giving some practical recommendations for the teachers about planning Between-Class Ability Grouping in enhancing the student Academic Performance and Learning Motivation;
2) Becoming a standard for policymakers in the school in arranging the class grouping regulation, especially in mathematics;
3) Showing the greater implementations of GeoGebra as a supporting tool in learning mathematics.

1.7 Thesis Overview

Chapter One introduces the background of the study, problem identification, scope and limitations, research questions, research objectives, significance of the study, and thesis overview. Chapter Two deals with the theories used to approach the problems to be studied. The definitions, characteristics, or indicators of the existing variables were explained. The variables studied in this study included the Between-Class Ability Grouping, Academic Performance, Learning Motivation and GeoGebra as a mediating variable. The hypotheses of the study are also stated in this chapter. Chapter Three consists of the analysis methods used in the research and the data along with their sources. Several sections in this chapter include the research design; location, time, and research subjects; research procedures; population and sampling; data collection; research instruments; and data analysis. Chapter Four provides detailed explanations, descriptions, or depictions of the research subjects in the thesis. The findings obtained in the research are presented in accordance with the theories outlined in Chapter Two. Chapter Five contains the summary of the answers to the questions posed in the research questions, from which the theoretical implications of this research have been formulated.