

## What Feminist Mathematics Education tells to South Korea?

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I examine the discussions of studies related to feminist mathematics education and the implications of mathematics education in South Korea. In particular, I attempt to answer the following questions through literature reviews on feminist mathematics: What is the epistemological background of feminist mathematics education? How is feminist mathematics education defined and implemented? What does feminist mathematics education suggest in South Korea's mathematics curriculum? From the analysis of the literatures, I found that feminist mathematics education reflects not just the rights of female's rights but also a paradigm shift in epistemology of mathematics and philosophy of mathematics education. In this regard, feminist mathematics questions the existing mathematics education related to the female students who were marginalized in the composition and delivery of mathematics. Feminist mathematics education points out that in the course of the transfer of mathematical knowledge in schools, female students understand unilateral information procedurally without understanding the concept. Mathematics educators should consider alternative curricula that reflect the views of female students regarding the nature of mathematics. Students should be able to receive equal mathematics education in a school regardless of their gender. In this case, equal mathematics education refers to education methods that are suitable for both male and female students. The existing mathematics content and its teaching methods were designed based on the learning experiences of male students, which made them relatively difficult for female students to understand.

*Keywords:* Feminist Mathematics Education, Feminism Mathematics Education, Constructivism, Mathematics Curriculum

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### I. INTRODUCTION

Evaluating mathematics from a feminist view point might be an important part of the discussion of the critique of the absoluteness of mathematics (Boaler, 1997). From a feminist perspective, mathematics or mathematics education is not objective (Damarin, 1991). This is because mathematics and mathematics education are based on the views of

members of society. It is important to involve scientists from different perspectives in building mathematical knowledge; this is because a variety of questions and approaches from a new perspective may lead to different conclusions from existing theories (Rosser, 1990).

Feminist mathematics focuses on female with a new perspective. Traditionally, the content of mathematics education and its teaching methods have been designed based on the learning experiences of male students (Boaler, 1997). As a result, apart from their ability to learn mathematics, female students are more unlikely to understand school mathematics content than male students and are excluded from determining mathematical knowledge (Damarin, 1991). In this discussion, female's mathematics learning outcomes are determined not only by their academic achievement in school education, but also by taking into account the willingness to complete mathematics classes in higher education institutions and the proportion of those in mathematics who specialize in mathematics (David, 2005).

Efforts to activate female's potential in mathematics and mathematics education are needed for the development of our society beyond the protection of female's rights. Modern societies based on advanced technology require excellent human resources in mathematics and science (Baro, 2001; Hanushek, & Kimko, 2000). Maximizing the mathematical capacity of female who have been neglected in the past should be considered in terms of securing human resources.

Discussions on feminist mathematics education have been undertaken worldwide for decades, based on the premise that a review of various philosophical positions may lead to changes in teaching methods in mathematics education and a social consensus on securing a female mathematics workforce. However, the discussion on feminist mathematics education in South Korean mathematics education has not received much attention. The study of feminist mathematics, its application and development of teaching and learning materials are also insufficient.

The discussion about understanding feminist mathematics education may not be new. However, it might be different in South Korean mathematics education research areas. The results of no literatures were inclusive when searching for “feminist mathematics education” from education search engine in South Korea such as DBPia and a South Korean Educational Research Search Engine may demonstrate the need for discussion regards epistemological understand feminism mathematics education in South Korea.

Although the term “feminism” might be not used in the study of mathematics education in South Korea, there were researchers who investigated the learning styles of female students (e.g. Lee, & Lee, 2011; Lee, & An, 2016). However, the study of the learning characteristics of female students and the study of mathematics education in feminist oligopoly should be distinguished. Feminist mathematics education research

goes beyond simply improving the achievement of female students in mathematics study. It is because feminist mathematics education research may put more emphases on understanding how female students have been discriminated in the classroom reflecting sociocultural structures.

Feminist mathematics education research is based on understanding how female students have been discriminated in classrooms that reflect sociocultural structures, rather than simply improving their achievement in mathematics. Therefore, I examine the discussions of foreign studies related to feminist mathematics education and examines the meaning of feminist mathematics education in mathematics education in South Korea. In particular, I attempt to answer the following questions through literature studies on feminist mathematics: What is the epistemological background of feminist mathematics education? How is feminist mathematics education defined and implemented? What does feminist mathematics education suggest in Korea's mathematics curriculum?

## II. LITERATURE REVIEW: EPISTEMOLOGICAL BACKGROUND OF FEMINIST MATHEMATICS EDUCATION

Regarding the view of mathematics, Joseph (1993) noted the philosophical premise that underlies Western (European) mathematics. The first premise is that mathematical knowledge is absolute truth, and the second premise is that mathematics is proved formally and deductively. However, Joseph (1993) pointed out that the method of rationally deduced in mathematics has been in use since the late nineteenth century, and that earlier forms of mathematical proof are more similar to those used in ancient China or India. In his explanation, mathematical proof before the nineteenth century meant verifying results in a variety of ways, including visual presentation rather than axioms and standards. Based on this argument, Joseph (1993) criticized the coercive and exclusive current mathematics hegemony that did not consider European and non-male mathematical thinking and proof methods. The belief that only European-centered mathematics methods are mathematical has resulted in ignoring and rejecting the mathematical culture and history of African, Asian and Latin American mathematics. This bias against mathematics must be overcome for the development of mathematics (Joseph, 1991; Needham, 1959; Nelson et al., 1993; van Sertima, 1986; Zaslavsky, 1973).

Mathematics, like anthropology and history, reflects the values of the person who created the concept (Harding, 1986). Defining the range of knowledge of mathematics itself represents the social nature of mathematical knowledge (Bloor, 1991). In his historical review of these arguments, Bloor (1991) explained that mathematics is not an absolute knowledge system, explaining the fact that mathematics appears in various

forms in society, depending on the social situation and time. He also explained that the reason why we now seem to think that mathematical knowledge is absolute and cannot be regarded in other forms is that we have not allowed it and we have educated students. It ignores the possibilities of various alternative approaches to mathematics or dismisses them in terms of error or non-mathematics.

Criticism of the absolute theory of mathematics led to the reflection of the method of mathematics education. Mathematics education is delivered to students in the form of absolute and objective information, rather than questioning and inquiring about existing mathematics knowledge. In this case, students rely on textbook content to understand mathematics. Under the premise that the mathematical meaning may not be changed, only the summarized mathematical knowledge is injected into students, the memorization of such knowledge is encouraged, and the competition between students is induced. Thus, mathematics is perceived by many as a solid system of knowledge that only a small number of students can understand (Rosser, 1993). Scholars who do not specialize in mathematics often criticize mathematics education for their inability to question and object to mathematical knowledge (Hirst, 1965/1974; Kelly, 1986). Mathematical knowledge, however, is a result of an array of objective information, sometimes even illogical, that is the result of an individual's thinking, inquiry, and imagination (Polanyi, & Prosch, 1975).

Mathematics education in the past has been based on the objectivism that there exists absolute and objective mathematical truth. In this sense, the purpose of mathematics education means to convey complete mathematical knowledge to learners and to accept them without criticism. This position can also be confusing for students to understand the process of constructing mathematical knowledge. For example, the mathematics curriculum in which mathematics are represented as a promised system and the mathematics commitments are staged by grade level is based on mathematical objectivism (Burton, 1995). However, what is described in the relativistic view of mathematical knowledge in this curriculum can confuse the teacher in determining the direction of mathematics instruction. For example, consider the math and curriculum.

Help students understand and master the concepts, principles, and laws of mathematics. Teach students to reason and communicate mathematically so that students can mathematically understand their surroundings, social and natural phenomena, and solve problems reasonably and creatively. Encourage students to develop desirable attitudes and practical skills as mathematics learners (Ministry of Education, 2015, p. 4).

Traditional teaching is a teaching-learning method in which teachers lead lessons through explanations and demonstrations, and is effective in structuring

and systematically teaching lessons. At this time, the teacher induces students to participate actively in class and appropriately utilizes questions to promote thinking (Ministry of Education, 2015, p. 38).

These statements raise the question of whether coexistence of understanding absolute and objective mathematical information with mathematical reasoning and creative solution is possible. These statements, in which the objectives of mathematical knowledge and the position of relativism are expressed at the same time, show that there is not enough discussion on how to view mathematics and mathematics education. Pure and objective knowledge has been found impossible in science and mathematics, but this view is still used as the dominant logic in mathematics and mathematics education (Polanyi, & Prosch, 1975). Constructivism, which refers to a methodological term that can replace absoluteness of knowledge in pedagogy based on its relativistic position, emphasizes the interactions between individuals, societies and knowledge in which mathematical meanings are made (Burton, 1995). Mathematics education from a constructivist point of view influences the way the classroom operates, organizes, and understands the roles and rights of teachers and students. In mathematics classrooms based on constructivism, learners are more important than mathematical knowledge itself. Mathematical knowledge is subjectively contextual, so mathematical knowledge can be understood differently by students.

Anderson (2005) suggested that the argument that mathematics was not value neutral was related to the view of feminism. A view on mathematics may involve the way mathematics seeks knowledge (Erchick, 2001). One of the most important power factors for determining mathematical knowledge is gender (Burton, 1995). The current European system of mathematics was built to reflect male's views (Joseph, 1993). The understanding of mathematics such as mathematics activities in the industrial revolution and traces of mathematics in ancient civilizations rather than the use of mathematics in everyday life at home is considered to be mathematics. It reflects thought and sight (Restivo, 1992). Feminist mathematics rejects the absolute and masculine view of mathematics and focuses on the relative and marginalized classes, which have been excluded from the discussion of mathematics, among the female's point of view.

### III. RESEARCH METHODOLOGY

In order to answer research questions of the paper, I analyzed related data by means of literature research. From the reviews, I have examined feminist mathematics books, dissertations, journals, conference proceedings, and other reports. For online research,

search for "feminism mathematics" or "feminist mathematics" and "feminist mathematics" independently in domestic and international educational research engines, or search for "feminism or feminist" or "feminism" and "Mathematics" was searched simultaneously. DBPia, Kiss, and Academic Education Center were used as South Korea research engines, and EBSCO, JSTOR, and SAGE Journal were used as international research engines. The criteria for the selection of analytical data in this study were first extracted from the most frequently cited data in consideration of frequency and academic contribution from relevant documents in domestic and foreign mathematics education.

At the time of this review, no studies satisfied the criteria from South Korea search engines. However, it may not indicate that there has been no studies for female students' mathematics education. From the gender equity perspectives, studies have been investigated the ways of improving female students' mathematics academics achievement. Although I distinguished feminist views from gender equity mathematics education, it is important to understand mathematics education for female students in South Korea. In order to understand mathematics education research for female students in South Korea, I further searched "female mathematics education" in the South Korean search engine.

The aim of this study is to provide implications for South Korean mathematics education studies from the perspective of feminist mathematics education. I reviewed the literature to provide basic data for understanding feminist mathematics education and the flow of South Korean mathematics education for female students. Therefore, no additional criteria were chosen for the literature study itself.

#### IV. RESULTS AND DISCUSSIONS

In this chapter, I analyzed the characteristics of feminist mathematics education that distinguished it from traditional education and gender equality education. Last section of the chapter include the results of analysis of papers related to mathematics education for female students in South Korea.

##### 1. FEMINIST MATHEMATICS EDUCATION: WHAT MAKES IT SPECIAL?

From a feminist point of view, mathematics education considers female to have their own views of mathematics, including questions, discussions, explorations and questioning. It also notes the rights and abilities of female in mathematics classrooms. Right here means going beyond mathematics lessons and building students' mathematical knowledge on their own. Therefore, in feminist mathematics education, teachers respect students' thoughts and experiences, plan curricula and classes around mathematics

knowledge that all students bring to the classroom regardless of gender, and make classrooms ideal for students to construct their own knowledge. Assume it is a form of math classroom. Mathematics classrooms from this perspective are students involved in mathematics learning, collaborate with each other, and respect their friends as mathematics learners, regardless of gender. In addition, mathematics classrooms from a feminist point of view reject the argument that mathematics is value neutral and respect various views of mathematics. Feminist mathematics education is based on a constructivist view of mathematics (Jacobs, 2011). Thus, feminist mathematics education may seem indistinguishable from student-centered constructivist mathematics education. However, what sets feminist mathematics education apart from constructivist mathematics education is that it focuses on the eyes of female students and the sociocultural environment surrounding them (Burton, 2012).

Mathematics education research based on feminist theory emphasizes the female students' views and feelings about the participation in mathematics classrooms (Damarin, 1995). The key to this research is to understand the situation of female students in mathematics education and to improve problematic situations rather than to identify differences among students by gender (Fennema, & Hart, 1994). Feminism's perspective in mathematics education helps students understand how students learn mathematics by analyzing their various identities (Burton, 2012). In particular, educational research conducted from the feminist point of view focuses on the power relation to the classroom relation. At this time, the power relationship may be due to gender or various differences. Educational research conducted in the context of feminism assumes that this relation of power can influence the learning process and outcomes of students (Anderson, 2005).

Feminist mathematics education is different from gender equality mathematics education. Diverse studies point out that feminist mathematics education focuses on the voices of female students who have been neglected in mathematics education, while gender equality mathematics education sees male and female from an equal perspective (eg. Esmonde, 2011; Lee, & Kim, 2017). Feminist mathematics education may focus more on oppressed experiences in mathematics education, while gender equality mathematics education may focus on the equal results of academic achievement (e.g. Forgasz, & Rivera, 2012; Jacobs, 2010; Sriraman, & English, 2009). A study on gender equality mathematics education analyzes gender equality problems of male and female students based on the analysis of their academic characteristics and attitudes (Lubienski, & Bowen, 2000). Gender equality mathematics education focuses on how schools, teachers and communities can provide more effective mathematics education for both male and female students (Airton, 2009).

McKee (1988) described the traditional male-centered approach in terms of "patriarchal". Based on McKee's argument, I summarize the characteristics of feminist

mathematics education research as shown in [Table 1].

**Table 1.** Comparison of traditional mathematics education and feminist mathematics education

Traditional mathematics education	Feminist mathematics education
Understand mathematics from a particular perspective	Construct the meaning of mathematics based on individual understanding and experience
Mathematics exists outside the world the learner belongs to and needs to be understood by the learner	Mathematics exists in the world of the learner and the learner can see critically about the mathematics
Distinguish logic and emotion, seek rational and objective knowledge based on logic	Intuition is also regarded as a way of rational knowledge
Male and female understand as equal learners	Gender is an important variable in learning outcomes
Difference between mathematician who makes mathematics and general learner	Mathematics is popular and can be made by anyone

[Table 1] summarizes the perspectives of existing studies to help understand feminist mathematics education, and is not an absolute definition of feminist mathematics education. [Table 1] should be understood as a reference that can be used as a basis for studying feminist mathematics teaching methods.

## 2. MATHEMATICS EDUCATION RESEARCH ON FEMALE STUDENTS IN SOUTH KOREA

As noted above, no feminist mathematics education studies were founded from the search parameters of the study. In South Korea, most of the studies involving female students were quantitative to analyze differences between males and females (Kim, 2019a). Due to the lack of qualitative analysis, there is not enough data available to understand the learning process of each male and female student (Kim, 2019a). Thus, this section may include the analysis of the South Korea quantitative research focusing on gender equity in mathematics education.

Recent studies have pointed out that the differences between male and female in mathematics achievement are decreasing (eg, Lee, & Lee, 2011; Lee, & Ko, 2014). Lee and Song (2011) argue that mathematics achievement of females was higher than that of males in elementary school (Lee & Song, 2011). However, South Korean female students do not prefer mathematics-related classes and careers more than male students (Lee, et al., 2016).

Where does this difference between academic achievement and preference arise? South Korean researchers demonstrate that differences in preference and achievement in mathematics classes are a matter of perception such as self-efficacy and interest in mathematics (Song, 2018; Lee, et al., 2016). Why, then, does the gender difference in



perception of mathematics occur?

Previous studies have found that socio-cultural factors affect mathematics achievement, rather than natural gender abilities. For example, in the Second International Mathematics Study [SIMS], Baker and Jones (1993) found that the difference in the mean of mathematics academic achievement by gender correlated significantly with measures of gender inequality across countries. Guiso et al. (2008) concluded that, as society is not equal in gender, mathematics achievement differs between males and females. If females are provided with educational and career choice opportunities and a social and cultural environment that supports them, the mathematics achievement of female students is improved (Hyde, & Mertz, 2009).

The difference in academic achievement by gender in mathematics is due to sexual inequality in society. According to social stereotypes and options of education including mathematics, mathematics achievement results vary by gender (Hyde et al., 2009).

### 3. IMPLICATIONS FOR FEMINIST MATHEMATICS EDUCATION STUDIES IN SOUTH KOREA

The purpose of this study is to understand the epistemological background of feminist mathematics education and to suggest implications for the study of mathematics education in South Korea.

#### *1) Why Feminist Mathematics Education Does Matter in South Korea?*

In 2018, South Korea's Gender Differences Index [GDI] ranked 118th out of 144 countries (World Economic Forum, 2018). The GDI is not the only indicator of gender equality in society, and the GDI does not represent all gender equality in society. For example, in the 2018 Gender Inequality Index released by the United Nations Development Program, South Korea ranked 10th out of 160 countries. However, considering that gender inequality in society may affect female students' perception of mathematics in the previous study, further investigation on the status of female students' recognition is needed. In spite of the fact that female students' mathematics achievement and mathematics learning ability might not be inferior to male students, if they do not prefer mathematics and mathematics classes and related careers, it is necessary to try to analyze the causes in the social environment.

Feminist mathematics education focuses on the sociocultural discrimination factors that may affect the learning of mathematics among female students (Burton, 1995). Given that the current study of South Korean mathematics education related to female students is focused on the improvement of mathematics academic achievement based on statistical analysis, feminist mathematics education to understand the sociocultural experience of female students may provide new ways of understanding female students' learning

processes.

Friedman (2005) pointed out that screening and nurturing mathematically talented students, regardless of gender, race or country, is important for social development. In mathematics, in particular, differences in males' and females preferences and academic achievements may be linked to gender composition issues within STEM (Science, Technology, Engineering, and Mathematics) related occupations that require mathematical knowledge (Kang, 2003). Efforts to activate the potential of female students in mathematics and mathematics education are needed for the development of society. Considering there has been not man discussions related female students' experiences in mathematics classroom in South Korea, I suggest that feminist standpoint may broaden our understanding of female students' mathematics learning process.

## ***2) Why Feminist Mathematics Education Does Matter in South Korea?***

The introduction of a new epistemological context of feminist mathematics education may raise questions about mathematics curriculum (Nickson, 1992). Given that feminist perspectives have been neglected in South Korean mathematics education research, the study of mathematics education from feminist perspectives may provide new directions for curriculum development including teaching methods.

Comparing the traditional mathematics teaching methods described in [Table 1] with feminist mathematics teaching methods, I found that there are differences in the space where mathematical concepts exist, the access to mathematics, and the process of acquiring mathematical knowledge. Looking at the South Korean Ministry of Education (Ministry of Education, 2015), I found the characteristics of traditional mathematics education. The mathematics curriculum does not specify how mathematics is viewed. However, it might be inferred from the following that mathematics and curriculum are viewed as a complete system that learners should understand rather than making mathematics themselves.

In the Mathematics classroom, students are taught to understand the concepts, principles, and laws of mathematics, to acquire skills, and to mathematically observe and interpret various phenomena around them. It also encourages students to develop the skills and attitudes to think logically and solve problems reasonably (Ministry of Education, 2015, p. 3).

Teaching mathematics in relation to life surroundings, social and natural phenomena, so students learn the necessity and usefulness of mathematics. Teaching students to recognize the role and value of mathematics (Ministry of Education, 2015, p. 39).

From the mathematics curriculum, it is noted that the teaching and learning method should be "to understand other people's ideas, express mathematical ideas and discuss them while respecting various viewpoints" (Ministry of Education, 2015, p. 39). It does not include specific explanations or recommendations on how the meaning of mathematics may vary depending on the background of the student or the level of understanding.

The scope of this study does not include the analysis and evaluation of mathematics and curriculum in terms of feminist mathematics. As I have seen, the problem of absolute mathematics continues to be raised, and the results of studies on the difference between male and female methods of learning mathematics continue and are reported. It is to suggest that we should be able to embrace education.

The existing mathematics content and its teaching methods in South Korea were designed based on the learning experiences of male students in general, making it relatively difficult for female students to understand (Kim, 2019a). For female students who have been marginalized in a mathematics classroom, it is necessary to develop the understanding and guidance method of the mathematics learning process of female students who have been alienated from mathematics education.

## V. CONCLUSIONS

The development of society and mathematics are intimately linked to each other, increasing the interest in school mathematics education (Kim, 2019b). The importance of mathematics education was also mentioned in the 2019 Ministry of Education's measures to strengthen basic mathematics education, introduce mathematics textbook verification system, and develop manpower for human resource engineering. However, references to female students in these proposals are difficult to find. In mathematics, research topics are often focused on areas where males may perform better than females (Research Advisory Committee of the National Council of Teachers of Mathematics, 1989). In addition, although efforts are made to train female scholars in science, mathematics and engineering, it is difficult for female to conduct new research in creative and productive ways in male-oriented mathematics and mathematics education (Damarin, 1995).

Belenky et al. (1986) research on the process of female's knowledge construction and Clinchy et al. (1985) on feminist teaching methods suggest the need for alternative teaching methods for females in all subjects, including mathematics. Current mathematics and curriculum do not reflect this view. Feminist mathematics education reflects not just the rights of female students, but also the paradigm shift of epistemology about

mathematics and philosophy of mathematics education. In this regard, feminist mathematics questions the existing mathematics education related to the female students who were marginalized in the composition and delivery of mathematics. Feminist mathematics education points out that in the course of the transfer of mathematical knowledge at school, female students understand unilateral information procedurally without understanding the concept. Mathematics educators should consider alternative curricula that reflect the views of female students regarding the nature of mathematics.

Further research needs to analyze feminist perspectives on the experiences and participation of female students in mathematics classrooms beyond the mathematics curriculum. Analysis of the characteristics of female students in the male-centered mathematics classroom, and the relationship between these characteristics and the effectiveness of mathematics learning should be investigated. Based on an understanding of the direction of mathematics and the curriculum and the learning characteristics of female students, a mathematics education model should be constructed that may provide equal education for all students regardless of gender.

There needs more studies focusing on feminist mathematics and feminist mathematics education in South Korea. A study on feminist mathematics education, which might be viewed as an alternative education method that changes the view of mathematics, rather than simply developing mathematics education methods for female students. Therefore, I examined the mathematics and curriculum from the perspective of feminist mathematics education. I attempt to question the epistemological understanding of feminist mathematics education and whether the entire mathematics curriculum, including mathematics teaching methods and assessment methods, is appropriate for all students. to be. Debate about how to view and teach mathematics and mathematics education from the viewpoint of females, not just to raise the mathematics scores of female students, should be continued in the domestic research field.

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