

A Systematic Review of Teachers’ Perceptions and Beliefs Towards Gender Issues in Mathematics Learning

Laxmi Sharma

Lecturer, Nepal Sanskrit University

Email: laxmioasis11@gmail.com

Prof. Lekhnath Sharma, PhD

Central Department of Education, Tribhuvan University

Email: sharmaln012@gmail.com,

Reader, Bishnu Khanal, PhD

Office of the Dean, Faculty of Education, Tribhuvan University,

Email: bkhanaltu@gmail.com,

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Abstract

There is still very little concern especially, regarding teacher's perceptions towards gender differences and their influences in mathematics learning. Teachers are prominent factors in mathematics learning and the importance of perceptions and beliefs of teachers towards gendering, their long-term influences and their differential impacts on males and females cannot be ignored. The purpose of this study is to synthesize existing researches related to teachers' perceptions and beliefs towards gender in learning Mathematics. A qualitative systematic review of related literature of teachers' perceptions and beliefs towards gendering in learning mathematics is conducted. The qualitative review has followed the PRISMA protocol that was outlined by Moher et al. Total of 10 articles (six quantitative, four qualitative including a systematic literature review) are chosen for inclusion for this study. Thematic analysis suggested by Braun and Clarke is used as a method to draw findings and conclusions by generating themes within the information. The thematic findings of the study are associated with the major themes that are related to teachers' perceptions and beliefs towards gender in mathematics learning. The findings are based on the major themes: participation and motivation; behaviors and performance; abilities and ICT use; teaching methods, curriculum and practices and career choices. Hence, the importance of exploring teachers' perceptions and beliefs towards gender issues in mathematics learning has been acknowledged in this study. The study has claimed that gender parity can be achieved when mathematics teachers believe that students (both boys and girls) are valuable potentials and they praise them for their effort and achievements to develop confidentiality in mathematical thinking and problem-solving abilities. Recommendations to the concerned stakeholders to enhance equity in mathematics learning are proposed in this study.

Keywords: belief, equity, gendering, performance, teachers' perceptions

Introduction

Gender is taken as an issue when a person feels that a certain inequality is injustice and it is a key variable which plays vital role in learning mathematics. Despite tremendous changes during the past decades, studies have consistently shown that girls often receive fewer opportunities to participate in mathematical activities than their male peers do. Gender disparities in various dimensions of mathematics learning are still in existence as burning issues. This can have a lasting impact on girls' academic success and career prospects. The disparity in mathematics learning across genders is connected to the gap in academic accomplishment and performance as well as the proportion of each gender in prospective employment.

Gender equity in mathematics learning is commonly expected as equity in participation, achievement, access the modern educational technology, representation in better job careers, leadership skills and policy making and implementing roles. But the reality is that the existence of differences between girls and boys in learning mathematics has been long accepted. Leder (2019) has reported that the presence of gender differences in participation in mathematics is evident when the subject is optional in college and university level. At the secondary level of schooling, disparities in educational achievement become more pronounced, and this persists in the areas of science, technology, engineering and mathematics, as well as at higher career levels.

Teachers are prime and prominent factors in mathematics learning. Their perceptions and beliefs towards male and female characteristics and capabilities influence the active participation of the learners. Their long-term differential behaviors and practices definitely affect and limit the effective achievement and performance of boys and girls in mathematics learning. Consequently, they have huge impacts in society, nation and the world. Fennema et al. (1990) have reported that numerous studies have shown that teachers do not treat girls and boys the same in classrooms and have further assumed that the teacher pupil interactions influence the development of internal motivational beliefs and influence the participation in autonomous learning behavior. The validity of teachers as the most influential element in the learning of mathematics cannot be overstated. They are indispensable forces behind any academic transformation and are the driving force behind educational transformation in schools. Their attitude and beliefs regarding mathematics have an immense impact on students' academic ability. Gender stereotypes are likely to be noticeably influential in mathematics and can lead to a fear of failure among female students (Correl, 2001).

In the context of Nepal, the outcomes of mathematics learning are not satisfactory enough although it is an integral part of school curriculum. Mathematics is compulsory up to grade ten and is an optional subject from grade 11 to university level (MOE, 2017). Gender gap in many aspects such as in participation in studying mathematics,

performance in mathematics learning, opportunities in carrier choices in mathematics related field, contribution in making educational policies and implementation and even in leadership roles are seen clearly. There are many factors affecting it. Teachers' perceptions and beliefs toward gendering in mathematics learning may be one of the major factors behind the situation.

Descriptions of the terms

Perception: Perception about an issue is an idea inside the person's brain. Through the idea, a person can see, understand and interpret the issue and behave accordingly. For this, our nervous system receives signals that stimulate our sensory systems. This helps us comprehend and make reasonable assumptions about our environment. Perceptions of teachers are associated with beliefs of teachers. Teachers' perceptions are the attitudes and beliefs of teachers related to their students' capabilities and performances and ways of mental impressions of comprehending and interpreting things (Lambert, 2017; Samuel, 2018; Okereke, 2022). Hence, perceptions and beliefs of teachers shape attitudes of teachers and hence behaviors of teachers are reflected in the classroom accordingly.

Belief: Belief is something that is accepted and considered to be true. It is psychologically accepted understanding or proposition about the world and thought to be true. It is a cognitive act in which the thing is believed. Phillip (2007) defined the term and compared with emotion and attitude as a more cognitive lens that affects one's perspective about the world or disposition towards action. Beliefs of a person determine the attitudes towards something. Pryor (2022) has written that belief can be acquired through direct observation or acceptance of information from other sources or by inferring new belief from existed beliefs. It is further stated that an attitude towards something is formed by evaluating a set of beliefs about the characteristics or attributes of it. Hence, teachers' beliefs have powerful educational influence on students learning.

Literature Review

Classroom interactions are heavily influenced by teachers' perceptions and beliefs about gender in mathematics learning. If teachers have notions that girls are less capable in mathematics, they may be more likely to focus their attention on boys, call on them more often and provide more positive feedback. In this regard, Fennema et al. (1990) have claimed that teachers interact more with boys calling them than with girls, praise and scold boys more than girls. Even though, they have doubt to conclude the evidence that interacting more and differently with different genders is the major factor for gender disparities in mathematics.

Perceptions and beliefs of teachers of mathematical capabilities can affect interests and confidence level of students in mathematical learning. Teachers have beliefs that men are naturally better at mathematics than women. Kaiser et al. (2012) concluded

from their large study of 1200 students that the belief that mathematics is a male domain still persists among German pupils and is more prominent among older youth, likely due to either encouragement from fellow students, their guardians, or academics.

No doubt, teachers' perceptions and beliefs shape teachers' behaviors and practices in the classroom. It is very important what views teachers transmit during instructional process of mathematics and what conceptions and beliefs students perceive themselves and shape their attitudes toward gender. This study is primarily focused on how teachers transmit gender stereotypes and stigmas present in the society to their students during their math instruction, resulting in an unequal treatment of girls and boys. Considerable researches have been carried out in the area of gender and mathematics learning. But there is still very little concern especially, regarding teacher's perceptions and beliefs towards gender differences and the influence of them in mathematics learning globally and the case is similar in the context of Nepal, too. Thus, it is realized that the importance of perceptions and beliefs of teachers, their long-term influence and their differential impacts on males and females cannot be ignored in learning mathematics. Hence, the main objective of this study is to synthesize the existing researches related to teachers' perceptions and beliefs towards gendering in mathematics learning. It is clear that the importance of exploring teachers' perceptions and beliefs towards gender issues in mathematics learning has been acknowledged in this study.

Research Questions

The main aim of this study is to consolidate knowledge about teachers' view and opinions about gender in order to create a greater sense of fairness in mathematics education. In order to gain an understanding of existing literature pertaining to this topic, the following research questions have been identified.

- (1) What are the perceptions and beliefs of teachers towards gender in mathematics learning?
- (2) How do existing researches characterize teachers' perceptions and beliefs towards boys and girls?

Delimitation of the study

Due to the time constraint, this research has to be bounded within these delimitation:

- (i) Only the two genders (male and female) are considered in this study.
- (ii) This study is concerned to analyze perceptions and beliefs of only teachers towards gendering in mathematics learning.
- (iii) This study is delimited to only 10 studies (six quantitative, four qualitative including a systematic literature review) conducted during 1990 to 2023.
- (iv) This study is only confined to qualitative systematic review method.

Methodology

The current qualitative systematic literature review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, which composes of 27 evidence-based items as outlined by Moher et al. (2009). A systematic literature review of researches on teachers' perceptions and beliefs towards gendering in mathematics learning during the period from 1990 to 2023 is conducted by using the steps: formulation of a plan, searching and screening the studies, analysis and interpretation of selected studies and finally drawing conclusions and recommendations.

Data Sources, Search and Inclusion

Two electronic databases ERIC (Education Resources Information Center) and JSTOR (Journal Storage) along with a search engine - Google Scholar are searched. Researches were collected during two months from February to March, 2023. Different journals, conference papers, books and book chapters are gathered through different online resources using different key words 'Teacher's perceptions', 'Teachers' beliefs', 'gender issues', 'mathematics learning' etc. Thousands of journals and related resources were found in the initial searching. Searches performed article abstracts. Only ten studies (six quantitative, four qualitative articles including a systematic literature review) which are peer reviewed and published in English scholarly journal are selected purposively for inclusion. The characteristics of included ten research findings are shown in the following table:

Author(s)	Published year	Cou ...	Samp le	Study design	Participants	Teachers' perceptions	Teachers' beliefs
Panthi and et al.	2021	Nepal	101	Quantitative	Teachers of Mathematics at all levels - from elementary to high school.	There is a distinct difference between genders when it comes to their levels of interest and ability to stay focused on higher level mathematics.	Parents give less priority to daughters' education so that they have fewer opportunities than sons
Ahslund and Bostrom (2018)	2018	Sweden	114	Quantitative	Elementary mathematics teachers	Boys are dependent, idle and unmotivated	-
Oppong-Gyebi et al.	2023	Ghana	69	Quantitative	Senior high school mathematics teachers	The mathematics curriculum is quite stringent and conceptual, more theoretical rather than practical applications.	-
Margot	2019	-	-	Qualitative	PreK-12	Interdisciplinary	Implementing

Author(s)	Published year	Country	Sample	Study design	Participants	Teachers’ perceptions	Teachers’ beliefs
and Kettler				ative system atic review	mathematics teachers in primary studies	STEM education initiatives that are captivating and genuine are highly beneficial for students.	STEM education requires a great deal of change to be made in pedagogical methodologies, curricula, assessment tools, assistance, and instruction.
Panthi et al.	2018	Nepal	3	Interpretive qualitative	Secondary mathematics teachers	Key elements of social justice in mathematics classroom are equality, equity, fairness and social process	-
Ransome et al.	2016	Trinidad and Tobago	165	Quantitative	Third- and fourth-year student-teachers of 4-year B.Ed. program	Students are driven by feelings, expectations and usefulness that could enhance their performance in mathematics	-
Sainz et al.	2021	Spain	36	Qualitative descriptive	Secondary school teachers	Girls generally excel in school, especially in the area of reading comprehension.	Social, cultural, and biological components are responsible for the disparities in educational pursuits among genders.
Upadhyaya and Eccles	2015	USA	849	Quantitative	Kindergarten to sixth grade students and their mathematics teachers	Younger boys demonstrate a higher level of self-concept when it comes to mathematics ability than both older children and girls.	-

Sainz et al.	2012	Spain	27 parents and 22 teachers	Qualitative	Secondary school teachers	Parents and teachers have pre-conceived notions about ICTs and believe that gender does not play a role in the academic decisions made by adolescents.
Fennema et al.	1990	US	38	Quantitative	First grade teachers	The cause of boys' accomplishments and disappointments is aptitude and for girls, it is hard work. The male student who is the best performing is more competitive, logical, and adventurous than the female student who is the best performing.

In this qualitative review of researches, thematic analysis suggested by Braun & Clarke (2006) is used as “a method for identifying, analyzing and reporting themes for different patterns within the data” (p.79). Similar ideas are kept in one code, other ideas in other codes and so on. Initial codes are selected to focus on chief objective of the study. Creating themes and sub themes, those initial codes are combined to five major themes and the thematic analysis and interpretation is done. The thematic findings of the study which are associated with the major themes are based on teachers' perceptions and beliefs towards gender on participation and motivation; behaviors and performances; abilities and ICT use: methods, curriculum and practices; and Career choices.

Results and Discussion

Participation and motivation

The major participants of the classroom are students. They provide energy and enthusiasm that can add to the learning process and make the classroom environment more engaging. The participation of students in mathematics learning should be encouraged and valued as it can help to make learning enjoyable, to build relationship among teachers and students and to foster critical thinking skills. Confidentiality of students, traits and skills of instructor, perceptions of classmates, size of classroom etc. are the major influencing factors in learning process (Abdullah et al., 2012). Interests and motivation of girls and boys towards mathematics play crucial role for the active participation in mathematics learning. The average perceptions of teachers showed that

female students have less interest in mathematics beyond schools and their parents have less priority to daughters' education so that they have fewer opportunities than sons have (Panthi et al., 2021). Hence, regarding participation and motivation of learners towards mathematics, teachers believe that girls have less involvement and enthusiasm than boys.

Behaviors and Performance

Behaviors include the behaviors of teachers and students. Teacher interacts frequently with the students. Definitely, overall behaviors of teachers, the way teacher interacts with students, the way of rewarding and inspiring students in the mathematics classroom influence the behaviors of students and consequently influence the performance of mathematics of students. Teachers hold the view that there are varying interpretations of the same behaviors for boys and girls due to gender stereotypes - girls exhibiting independence and having strong communication and organizational abilities as opposed to boys being unconcerned, unmotivated, and immature. (Ashland & Bostrom, 2018). Teachers have different beliefs about performance toward gender. Girls' academic achievement was attributed more to effort than intelligence and reversely the usual tendency to associate boys' good academic performance with intelligence (Sainz et al., 2021). On the contrary, it is seen that girls who are more confident in their mathematics abilities and less anxious tend to perform better than boys. Teachers have stated that girls' performance in all subject matters is superior during the early years of compulsory school education in Spain (Sainz et al., 2021). Boys and girls have different classroom behaviors and academic performance in mathematics learning but with the proper support, both genders can excel in the subject.

Abilities and ICT use

Mathematical thinking ability is a critical skill for students' success in the 21st century. In order to foster mathematical thinking, teaching must be based on methods that stimulate students' problem-solving and logical understanding. The employment of information and communication technology (ICT) is a significant means for encouraging effective mathematical reasoning. Students have shown that boys and girls may have different approaches to and preference for using ICT to support their mathematical thinking. It is believed by teachers that their assessments of their students' natural ability in mathematics can be a strong indicator of how they will view their capability in both math and literacy currently and in the future (Upadhyaya & Eccles, 2015). Further, regarding the use of ICT, teachers perceive and believe that IT field as male domains (Sainz et al., 2012). In the same way, there is a rooted gender stereotypes that Mathematics as a male domain. Thus, teachers believe that mathematical ability and ICT use are in the favor of males.

Teaching Methods, Curriculum and Practices:

Gender disparities in mathematics education have been well documented. Girls and boys are not proportionally represented in certain areas of mathematics. This is the result of a number of factors, including differences in the ways teachers teach mathematics, the types of curriculums used and the classroom practices employed. Some teachers have advocated for more flexible and engaging secondary school curricular programs to sustain the attention of students, particularly boys, who can easily become disinterested (Sainz et al., 2021). Mathematics teachers have different hopes from male and female students in the classroom, and interact with them differently. They have claimed that perceptions of teachers affect their actions and hence biased perceptions of teachers may influence in teaching and learning opportunities for students. Regarding unequal classroom practices, Panthi et al. (2021) have pointed various factors such as teacher's behavior and carelessness, curriculum, teaching methods, social and cultural environment, sitting arrangements, ability differences, interest and motivation in learning and availability of teaching learning materials and resources are the prominent factors for a lesser chance of equal opportunities in the classroom. Hence, teachers believe that teaching methods used by mathematics teachers, existing curriculum and practices in the academic institutions have great role in creating gendering in mathematics learning.

Career Choices

Gender inequality in mathematics learning can have a profound impact on students' representation in science and technology, as well as on their career choices. Teachers' perceptions and beliefs toward gender realities in mathematics learning are important in helping to create an equitable learning environment for all students. Most teachers acknowledged that there was a lack of girls in science and technology, whereas boys were scarce in the humanities and social sciences. (Sainz et al., 2021). In this regard, teachers viewed that girls have fewer future opportunities than boys because of their less interest in learning and their parents' minimum motivation towards daughters' education (Panthi et al., 2021). Variance between teachers' age, gender, experience, and the perceived value of STEM education could influence their activity and passion for an extensive STEM program at the school and consequently similar influences are reflected in the better prospective employments.

Conclusion

Sound mathematical knowledge is essential for all genders for the overall development of any society. Perceptions and beliefs of teachers towards gendering in mathematics learning play prominent role to achieve equity in terms of participation, performance and future career choices in the subject. But teachers' perceptions and beliefs are not in favor of girls regarding participation and motivation; behaviors and performance; mathematical ability and ICT use; teaching methods, curriculum and

classroom practices and hence influences are reflected in the future career choices related to mathematics learning. The teachers are also the products of perceptions/beliefs embodied and gender biased in mathematics learning. Therefore, the issues as such are determined considerably more by stakeholders ‘cultural and behavioral practices than the biological ones.

Implications

Greater considerations should be prioritized to enhance sound environment in mathematics classroom and develop positive motivation and interests toward mathematics learning. In order to do this, real opportunities in the classroom, performances of both boys and girls and gendering should be discussed fairly (Ahslud & Bostrom,2018). Creating and promoting supportive learning environment is an important factor for considerable participation of boys and girls both in learning mathematics (Kaur et al., 2022). Teachers must be aware of the potential impact that their own subconscious biases can have on how they view and interact with male and female students in the mathematics classroom. It is important for teachers to be intentional in creating an equitable learning environment for all students. Ahslud and Bostrom (2018) have reported that teachers must be ready to discuss critically about their teaching methods along with their students' performances and behaviors for development of inclusive environment for all boys and girls. Moreover, teachers should be aware on gender sensitivity in the teaching learning process and always attempt to implement gender responsive pedagogy and practices to maintain gender justice in mathematics learning.

Gender parity can be achieved when mathematics teachers believe that students (both boys and girls) are valuable potentials and they praise them for their effort and achievements to develop confidentiality in mathematical thinking and problem-solving abilities. Teachers can help to ensure equitable representation in science and technology by promoting STEM related careers and highlighting successful women in these fields. These can be done through the use of guest speakers, field trips and other activities that highlight successful women in STEM. These activities can be used to inspire and encourage students of all genders to pursue scientific and technological careers.

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