Undergraduate Female Students' Motivation and Perceived Self-efficacy in Mathematics

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Abstract

This article aims to describe undergraduate-level female students' motivation, interest, and perceived self-efficacy in mathematics. This is a cross-sectional discriptive study. All 84 female students who were studying mathematics at the undergraduate level in the selected nine different campuses of Tribhuvan University(TU) of Kathmandu valley and one campus of Kathmandu University (KU) were included as a sample of the study. Data were collected from sample female students through a self-administered questionnaire. Female students were found to be motivated and encouraged by their parents and teachers to study mathematics at undergraduate level. Fifty-two percent of respondents were confident in obtaining A grade in mathematics but most of them have a moderate level of self-efficacy to learn mathematics concepts and theories. Self-efficacy belief is significantly higher among daughters of educated mothers (above high school) (79%) compared to daughters of mothers with high school education and below (43%). Perceived self-efficacy of the female students is influenced by various factors including the educational status of parents, family support, and teachers' encouragement. Association between parents' education and self-efficacy is found significant at p-value < 0.05. It can be said that parents' education and teachers' encouragement influence the mathematical self-efficacy of female students to some extent.

Keywords: mathematics, motivation, self-efficacy, female students, undergarduate level.

Introduction

Mathematics is essential in every aspect of everyday life as it helps us do many things and think critically and logically. Being a useful subject, it may be difficult to live a normal life in very many parts of the world without mathematical knowledge (Githua & Mwangi, 2003). Mathematics is considered as a mother of all sciences because mathematical knowledge plays a crucial role in understanding the contents of other sciences including social sciences. It is the foundation of scientific discovery and technological advancement that is essential for the socio-economic development of the country. Students can be motivated if they understand the value and

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need of mathematical knowledge in their daily lives and the foundation of science, technology, and development. However, mathematics is considered a difficult and boring subject by many male and female students. Consequently, many students do not like to choose mathematics as a major subject in their undergraduate studies.

In Nepal, enrollment of female students in Medicine, Science, and Technology in higher education is increasing and reaching toward gender equality. But the status of women in mathematics in higher education has not improved despite the increased access of female students to higher education. Only a few female students are found studying at the post-graduate level. Low participation of female students might be affected by several factors including intrinsic factors such as perceptions, confidence, self-efficacy, anxiety. Most girls in Nepal feel that mathematics is a difficult and challenging subject. Female students in rural Zimbabwe also perceive mathematics as a difficult and male domain subject as well as irrelevant to their professional career in the future as described in a qualitative study done by Gudyanga, Mandizvidza, and Gudyanga (2016). Teachers and parents do not motivate girls to go for mathematics field in higher education. Another study conducted at the university level in Swaziland reported that female students were less likely to be encouraged by teachers to choose mathematics majors though they had self-confidence in mathematics (Kaino, 1997). It was also found that women and girls' ability to do mathematics, lack of confidence in mathematics, and perceptions of mathematics as a male domain subject are responsible for the low participation of women in mathematics (Odogwu, & Lawal, 2018).

Students with no interest or low interest and a moderate level of self-efficacy are more likely to go for non-STEM fields where mathematics is not a compulsory subject (Aryee, 2017). Edzie (2014) argues that those female students who are good at math and science are likely to enroll in STEM and study mathematics. Ackerman, Kanfer, and Beier (2013) examined gender differences and trait complex for predicting college success and persistence in science, technology, engineering, and math (STEM) fields. It was found that women who left STEM majors and chose non-STEM majors had a lower score on Mathematics and Sciences, and higher scores on the anxiety trait complex. Girls with a high level of confidence doing mathematics and science are more likely to choose math or STEM-related subject as major subjects in their undergraduate courses (UNESCO, 2017). In Nepal, the number of female studentsstudying mathematics subjects in the STEM field and humanities is very low. It is also not known whether the

low participation of female students in higher education is due to the lack of self-efficacy, motivation, or other reasons. Therefore, this paper analyzes and describes the motivation and self-efficacy of female students studying undergraduate level in their mathematics subject.

Methodology

This study was conducted in purposively selected ten campuses of two universities by employing a cross-sectional descriptive survey design. Nine campuses from TU, are located in Kathmandu Valley and one from KU is located in Dhulikhel. A total of 84 female students were found studying mathematics at the undergraduate level (BA/BSc/BMathSc) in the selected Campuses at the time of the survey. All 84 students in those campuses were included in the study as a sample. Quantitative methods and procedures were used to collect and analyze the data. The self-administered questionnaire survey technique was used to collect data from the sample female students. Researchers clearly explained the purpose, possible benefits, and risks of the study and obtained informed consent before administering the questionnaire among them. Then structured questionnaires consisting of background information, motivation, and self-efficacy measurement scale were administered to the sample students. Data collected through a self-administered questionnaire were coded and entered in computer using the SPSS program. Specifically, the data were analyzed using simple descriptive statistics: percentages, means, frequencies, chi-square, and t-test.

Results

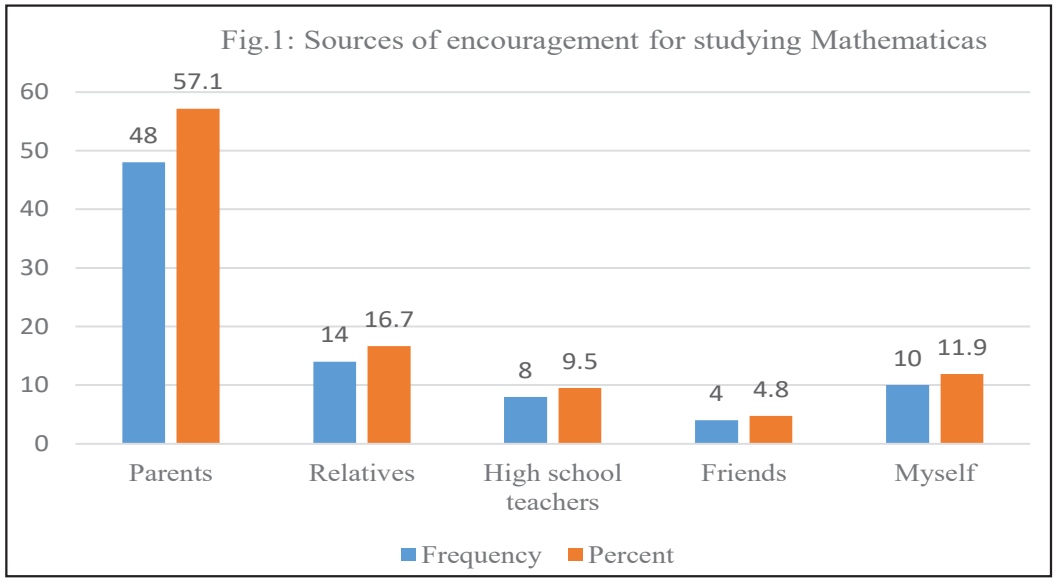
Background characteristics of respondents

All 84 female students participated in the self-administered questionnaire survey. Of the total students, 83 percent were studying physical science including mathematics (B.Sc.) and 17 percent were studying BA mathematics. The majority of them were from Brahman/Chhetri community, 20 percent were advantaged Janajati (Newar, Gurung, and Thakali) and 11 percent were disadvantaged Janajati category. The share of the respondents from Madhesi and Dalits was very low. It indicates that female students from disadvantaged Janajati, Madhesi, and Dalits are less likely to get enrolled in undergraduate mathematics courses. About 42 percent of the respondents' fathers had higher education and 36 percent had high school education. The highest percentage of the respondents' mothers had high school education (42%), followed by higher education (29%), no education (18%), and basic education (12%). The background characteristic of the students is shown in the table below.

Table I: Background characteristics of respondents/undergraduate female students

Backgrounds		Number n=84	Percent
Study field			
	BSc (Physics/ Maths)	70	83.3
	BA (Maths)	14	16.7
Caste/Ethnicity			
	Brahman/Chhetri	52	61.9
	Advantaged Janajati	17	20.2
	Disadvantaged Janajati	9	10.7
	Madhesi	4	4.8
	Dalit and others	2	2.4
Father education			
	Higher education	35	41.7
	High school	30	35.7
	Basic education	13	15.5
	No education	6	7.1
Mother education			
	Higher education	24	28.6
	High school	35	41.7
	Basic education	10	11.9
	No education	15	17.9

Motivation and Influencing Factors



Respondents were asked to respond about sources of encouragement, shown in the figure above, to go for mathematics study at the undergraduate level. The majority of respondents reported that parents encouraged them to enroll and study mathematics courses at the graduate level. About 17 percent were encouraged by their relatives to get to the mathematics field. Only 12 percent reported that they chose mathematics courses along with physical science on their own interest and decision. About 10 percent chose the mathematics courses due to the influence of science teachers of high school.

Table II: Factors motivating students for choosing and studying mathematics

Encouragement and motivation factors	Number	Percent
I want to make my career in the mathematics-related field	38	45.2
I would like to be a woman mathematician	16	19.0
I can get a job easily	14	16.7
I want to be a good teacher of mathematics	16	19.0
Total	84	100.0

The highest percentage (45%) of respondents were motivated to study mathematics courses in their undergraduate study because they wanted to make a career in a mathematics-related field. About 20 percent said that they chose mathematics courses because they had a keen interest to be a woman mathematician in the future. Another one fifth wanted to be a good teacher of mathematics subject.

Perceived self-efficacy

In this study, an attempt was made to assess the perceived self-efficacy of the girl students in mathematics. Perceived self-efficacy is students' belief about their capabilities to study mathematics at designated level performance. Surprisingly the majority of female students were not sure about their self-efficacy in mathematics performance. Only 30 percent of students reported that they are confident in their capacity to produce excellent performance in mathematics courses. However, 74 percent were certain that they can develop the knowledge and skills taught in mathematics courses,

Table III: Undergraduate female students' self-efficacy in mathematics

Self-efficacy	Agree/ yes	Not sure	Disagree/ no	Total n=84
I am certain that I can understand the most difficult material presented in the textbook used in mathematics courses	29.8	63.1	7.1	100.0
I am certain I can master/develop the skills being taught in mathematics courses	73.8	26.2	0.0	100.0
I expect to do a good performance in my mathematics subject	96.4	3.6	0.0	100.0
I am confident that I can obtain A Grade in Mathematics	52.4	45.2	2.4	100.0
I am confident in my ability to learn advanced mathematical concepts and theories.	83.3	14.3	2.4	100.0

About thirty percent of the respondents were sure that they can understand the most difficult material presented in the textbook. However, 52 percent of students confidently said that they can obtain A grade in mathematics. Most of the students were also confident in their abilities to learn mathematical concepts. From the findings, it can be said that most of the female students have a moderate level of capacity to learn mathematics concepts and theories.

Factors associated with self-efficacy and intention to be a mathematicians

Students were asked to express their perceived capacity to obtain A grade and do an excellent performance in mathematics. About 69 percent of female students whose fathers had higher education were confident to obtain A Grade in a mathematics course. This is significantly higher than among students whose fathers had educational qualifications with high school and below level. Likewise, self-confidence is significantly higher among daughters of educated mothers (above high school) (79%) compared to daughters of mothers with high school education and below (43%). The proportion of students having the confidence to obtain A grade in mathematics is slightly higher among female students from Brahman/ Chhetri (56%) than Janajati and others (47%). But the difference is not statistically significant at 0.05 p-value.

Table IV: Factor associated with self-efficacy

		Confident to obtain A grade in Mathematics		Total	Chi-square value	*P*-value
		Yes	No			
Father education	Higher education	68.6%	31.4%	100.0%	6.305	0.05
	High school and below	*40.8%*	*59.2%*	*100.0%*		
Mother education	Higher education	79.2%	20.8%	100.0%	9.71	0.01
	high school	42.9%	57.1%	100.0%		
	Basic education	40.0%	60.0%	100.0%		
Caste category	Brahman/Chhetri	55.8%	44.2%	100.0%	. 628	. 428
	Janajati and others	46.9%	53.1%	100.0%		

Discussion

Results of quantitative data analysis revealed that the majority of students chose mathematics courses at the undergraduate level due to motivation and encouragement received from their parents and teachers. Only 12% of students were found self-motivated to choose mathematics courses at the undergraduate level. Findings suggest that majority of female students were unable to make decisions about making choices about subjects and courses after passing grade 12 courses. This also indicates that female studentsof the least developed countries like Nepal require family support, and teachers' encouragement to motivate them in the mathematics study at the university level. Even in a developed country like the United States of America, female students from minority communities reported that family support was a great source of motivation for them to enroll and persist in STEM-related subjects including mathematics at the university level (Talley and Ortize, 2017). Students' motivation in mathematics study is influenced by both intrinsic/personal and external factors. External factors including family support and encouragement appear to be the main factor that motivates female studentsin studying mathematics. In order to motivate students in mathematics study, parents and teachers should make efforts to raise interest among them. Interest may be the critical factor for the cognitive and affective motivational force that guides attention and facilitates learning (Denissen et al. 2007), develops intentions through experience (Azevedo 2005; Krapp and Lewalter 2001), and influences career choice (Lent et al. 2008).

Young women's intention to study mathematics courses including physical science was to make a career in science and the mathematics-related field. About one-fifth of the female students reported that they had a kin interest to be a good mathematician. Likewise, only 19% intended to be good mathematics teachers in the future. Female students' intention to study mathematics courses can be explained by the theory of planned behavior (Ajzen, 1991). According to this theory, the intention of the students is determined by three constructs: attitude (perceived consequences of performing a behavior), subjective norm (perceived social pressure to perform the behavior), and perceived behavioral control (the extent to which a person feels able or not able to enact a behavior). To understand how motivation and intention influence female studentsin enrollment and persistence in mathematics study at the university level, constructs and variables of the theory of planned behavior need to be included and analyzed in the study. However, this study attempted to explore only the motivation and intention of the female students.

Results of the study indicate that female student had a moderate level of self-efficacy since most of them were not sure about doing very well in mathematics subjects. Only 52 percent of students were found confident in obtaining A grade in mathematics subject. It was assumed that student self-efficacy may be influenced by several factors including the education of fathers and mothers as well as caste background. This study found that the education status of a parent can influence the self-efficacy of female students to some extent. But perceived self-efficacy was not associated with the caste and social class of the students. Confidence in doing mathematics study, educational and career choices may be associated with the self-efficacy of female students. Oakes (1990) found that social factors such as parents, family, school resources, and teachers were associated with the mathematics self-efficacy of the students. Bandura's (1986) theory on self-efficacy is essential to explain the mathematics self-efficacy of young women.

Conclusion

Motivation and interest are crucial for female students to go for mathematics study in higher education. The parent' support and motivation and teachers' encouragement can play a vital role for female studentsin pursuing mathematics courses at the undergraduate level. It can be said that female studentsare less likely to choose mathematics courses at the university level in their interest. They have a moderate level of capacity to learn mathematics concepts and theories. Perceived self-efficacy of the female

students is influenced by various factors such as the educational status of parents, family supports, school resources, and teachers' encouragement. While this study is a first step in gaining an understanding of the sources of student self-efficacy beliefs, in-depth study needs to be done to explore various intrinsic and extrinsic factors including the social and learning environment that led to the formation of positive attitude and self-efficacy beliefs in mathematics study.

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