

Prospective Teachers' Myth about Mathematics

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Abstract

There are many beliefs about mathematics that contain the kernel of truth most of them are false but popular. Such false popular beliefs are myths, passed from generation to generation. These widespread myths can negatively affect young students and lead to maths phobia, prejudice, anxiety etc. This research paper explored some of the myths about mathematics among prospective teachers. The sample of the study consisted of thirty-two B.Ed. students, who had mathematics as a major subject, selected from three central universities in India. Myth-survey questionnaire and interview schedule were used to collect the information. The findings revealed that the common myths among the prospective teachers were: 'mathematics requires logic, not intuition', and 'mathematicians do mathematics problems quickly in their heads', etc. Despite the many limitations of this paper, the findings have scope for future research. Prospective teachers, school teachers, and teacher educators come under the ambit of this paper.

Keywords: *Prospective teachers, myths, myth about mathematics,*

1. Introduction

Myth is an idea or story that is believed by many people but that is not true (Merriam-Webster Dictionary). The following narrative referred to in Clements & Sarama (2018), represents a myth about mathematics.

"My daughter just does not understand maths. I told her, 'Don't worry, honey. I was never good at Math either.'"

"I know," replied her friend. "Some people are Maths people, and some aren't" (p.1).

First, the conversation says that only a few brilliant people in mathematics are successful, and second, the myth that women are typically incompetent in mathematics is sensitive but risky. Such false and popular beliefs or myths that are perpetuated in society without evidence, proof, are passed on to the next generation in the course of time. There are several myths about mathematics, viz., males outperform females in mathematics (Damarin, 2008), only a small number of 'talented' people succeed in mathematics (Clements & Sarama, 2018), etc. These myths "emerge from the uncritical verbalization of hopes and fears. It flourishes by repetition and authoritarian tradition, is sustained by coercive control" (Bain, 1947, p.61).

There can be many sources that cause the development of myths such as word-of-mouth, inferring causation from correlation, desire for easy answers and quick fixes, selective perception and memory, personal experience, exaggeration of the kernel truth, terminological confusion (Lilienfeld, Ruscio & Beyerstein, 2011), etc. Personal experiences, including

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experience as students in traditional math classes, affect pre-teachers perspectives on teaching, learning, and mathematics (Ebby, 2000). It is widely argued that false beliefs and myths about mathematics are widespread among the students (Mtetwa & Garofalo, 1989). Students held myths about mathematics that were developed before and during their school years, and these myths could be reinforced by daily life experiences (Tekkaya, 2002). Myths are potentially harmful to the person who holds them because of such beliefs about mathematics can lead to false impressions of how mathematics is done. The research suggests that “teachers’ beliefs, views, and preferences about mathematics and its teaching played a significant, albeit subtle, role in shaping their instructional behaviour” (Thompson, 1984, p.105). Since teachers have a great impact on the development of positive beliefs and attitudes of students towards mathematics. These teachers, who do not understand much about their subject, pedagogy, and held myths, can impose fear on the students to discourage them from asking questions that might expose the ignorance of teachers.

Although many myths about mathematics are present in students, they are also widespread among prospective teachers; teachers with myths about mathematics prefer to pass them to their students by adopting traditional teaching in the classroom (Tharp, 1989). When myths about mathematics prevail among prospective teachers, they will impede quality education; prospective teachers will pass on the same myths to their students, which, in turn, will lead to myth cycles. Hence, it is important to break such cycles in order ‘to mathematize (to consider or express mathematically) the child’s mind’ (National Curriculum Framework, 2005) and to achieve the goal of mathematics education in schools. Keeping in mind the above issues, the objectives of the present study were: (i) to identify different myths about mathematics from the related literature (ii) to study the myths that prospective teachers appears to hold about mathematics and (iii) study perceived sources of the myths that prospective teachers convey about mathematics.

2. Methodology

2.1. Sample

The main purpose of the study was to explore prospective teachers’ myths about mathematics. The sample of this study comprised thirty-two students enrolled in B.Ed programs with mathematics as a major subject, selected purposively from three central universities in India. The mean age of the sample was 23.5 years.

2.2. Instruments

In this descriptive survey research, data was collected using a myth-survey questionnaire and the interview schedule. The first part of the questionnaire requested demographic information including age, sex, and major subject etc. while the second part contained fifteen closed ended (yes/no) type items as shown in Table 1. The survey questionnaire was developed in the second phase of the study. Keeping time, resources and other factors in mind, the

researcher decided to conduct a telephonic interview using the schedule. The consent was sought from the participants prior to the administration of the tools.

3. Results and Discussion

One of the objectives of the study was to identify various myths about Mathematics from related literatures.

3.1. Myths about Mathematics

The researcher reviewed the related literature and identified some of the myths about mathematics for the present study as mentioned in Table 1.

Table 1: *Myths about Mathematics identified from related literatures*

S. No.	Myths	References
1.	Some people have a mathematics mind and some don't.	Franks (1990, p.11).
2.	Mathematics requires logic, not intuition.	-do-
3.	Mathematics requires a good memory.	-do-
4.	There is one best way to do a mathematics problem.	-do-
5.	Mathematics is done by working rigorously until the problem is solved.	-do-
6.	Men are better in mathematics than women.	-do-
7.	In mathematics, it is always important to get the answer exactly right.	-do-
8.	Mathematicians do mathematics problems quickly in their heads.	-do-
9.	There is a magic key for doing mathematics problems.	-do-
10.	Mathematics is not creative.	-do-
11.	For doing sum, it is bad to count on fingers.	-do-
12.	There is only one correct way to solve any mathematics problem.	Schoenfeld (1992, p. 359).
13.	The mathematics learned in school has little or nothing to do with the real world.	Schoenfeld & Sloane (2016).
14.	Mathematics is more difficult than any other subject.	Mathipedia (n.d.)
15.	Mathematics is for some bright kids with mathematics genes.	Lee & Ginsburg (2009. p. 38).

3.2. Description of Myths and Facts

Myth I: Some people have a mathematics mind and some don't.

FACT: The fact is the minds of people are raised differently. Mathematics relies on practice, so that is why one cannot claim that some people have a mathematics mind, and some don't.

Myth II: Mathematics requires logic, not intuition.

FACT: The fact is math requires logic as well as intuition. Many times before or while solving a problem in mathematics intuition and insight are required. Hersch (1998) argues that “intuition is an essential part of mathematics”(p. 61). Burton (1999) suggests that mathematicians and those responsible for learning mathematics should open up mathematical activity to include the subjectivity of intuitions.

Myth III: Mathematics requires a good memory.

FACT: The qualifier ‘good’ is not the same for everyone. The fact is that everyone can learn mathematics. Mathematics, like other disciplines, has its own vocabulary, terminology, etc. This needs a little memorization and more understanding and applications. The knowledge of mathematics cannot be acquired through rote memorization.

Myth IV: There is one best way to do a mathematics problem.

FACT: There is no best way to do a math problem, as the problem can be solved by a variety of methods representing creativity and originality. Students develop new and interesting methods for all stages of mathematics whether in solving algebraic equations, trigonometry, and calculus, etc. The best method is the one in which a student feels most comfortable.

Myth V: Mathematics is done by working rigorously until the problem is solved.

FACT: The fact is that rest and hard work are needed to solve any kind of problem, including a mathematics problem. Going away and coming back to a problem helps the mind to assimilate and develop ideas. Often a fresh insight is gained when it returns to a problem that unblocks the solution.

Myth VI: Men are better in mathematics than women.

FACT: There is nothing implicit in preventing women from learning mathematics at the same level as men. In reality, research has not shown any difference between men and women in mathematical ability. Boys and girls may be born similar potentials, but they may end up displaying differences because of a number of socio-cultural factors (Haider, Taufeeque, & Alam, 2019; Kane & Mertz, 2012).

Myth VII: In mathematics, it is always important to get the answer exactly right.

FACT: The opportunity to get approximate answers is often more important for mathematics than for accurate answers. For example, the problems of logarithmic, irrational numbers, and abstract algebra, etc. produce approximate answers.

Myth VIII: Mathematicians do mathematics problems quickly in their heads.

FACT: Speed is not a test of capability. It is the product of experience and practice. Mathematicians can do mathematics quickly only if they have already solved such related problems.

Myth IX: There is a magic key for doing mathematics problems.

FACT: There is no formula, rule, or general guideline which will suddenly unlock the mysteries of mathematics. If there is a key to doing mathematics, it is in overcoming anxiety about the subject and in using the same skills you use to do everything else.

Myth X: Mathematics is not creative.

FACT: Mathematics as a creative art. It requires imagination, intellect, intuition, and aesthetics about the rightness of things. In mathematics, “one and the same human being can be both a problem-solver and a theory-creator, but, usually, he is mainly one or the other. The problem-solvers make geometric constructions, the theory-creators discuss the foundations of Euclidean geometry; the problem-solvers find out what makes switching diagrams tick, the theory-creators prove representation theorems for Boolean algebras. In both kinds of mathematics and in all fields of mathematics the progress in one generation is breath-taking” (Halmos, 1968, p. 380).

Myth XI: For doing a sum, it is bad to count on fingers.

FACT: It is not incorrect to count on fingers as an aid to do arithmetic. Counting on fingers implies a sense of understanding arithmetic rather than memorizing everything.

Myth XII: There is only one correct way to solve any mathematics problem.

FACT: There may be a number of possible ways to solve the problem. For example, a cube of ninety-nine can be solved simply by multiplying ninety-nine three times. The same problem can be solved by using the algebraic identity method.

Myth XIII: The mathematics learned in school has little or nothing to do with the real world.

FACT: School mathematics is relevant to deal with many real world problems. It develops logical and critical thinking. Mathematics is not just a matter of counting. It is used in our daily lives, including finding distance, travel time and cost, shopping for the best price, purchasing at the best price, money management, etc.

Myth XIV: Mathematics is more difficult than any other subject.

FACT: Difficulty is a subjective term that depends on a number of factors. Mathematics is no more difficult than any other subject.

Myth XV: Mathematics is for some bright kids with mathematics genes.

FACT: Children enter mathematics classes at different preparatory levels. Some of these children had parents who drilled them from a young age in mathematics, and others may never have had this kind of parental guidance. Mathematics genes are not required to perform mathematics.

The aforementioned fifteen myths about mathematics are documented in the literature. Although the list is not exclusive, these myths are common, hence, these myths were taken to form the myth-survey questionnaire. The survey questionnaire was administered to

prospective teachers. The results of the prospective teachers on these myths about mathematics are presented in the following section.

3.3.Prospective Teachers' Myths about Mathematics

One of the objectives of the study was to study the myth about mathematics held by prospective teachers. For this reason, a questionnaire comprising fifteen Yes/No type items were administered. The data analyzed in percentage form is shown in Figure 1.

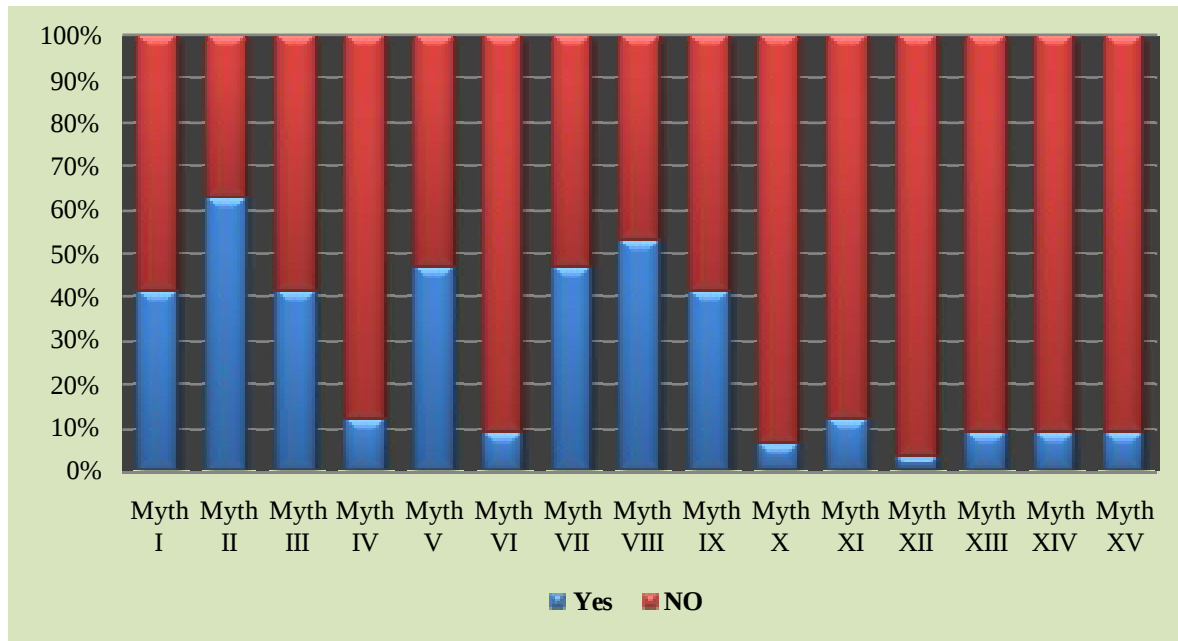


Figure 1: Prospective teachers' responses on Myth-survey statement

Myth I: Some people have a mathematics mind and some don't.

In response to the first myth, 41% of prospective teachers agreed that some people had a mathematical mind. The findings of this study are consistent with the earlier study, which shows that about sixty-three per cent of prospective teachers have the same myth (Frank, 1990).

Myth II: Mathematics requires logic, not intuition.

The majority of prospective teachers (63%) believed that mathematics required logic, not intuition. It can be inferred that the myth is commonly prevalent among prospective teachers. A similar result was found by Frank (1990) that about fifty-seven percent of prospective teachers held the myth. Among other myths held by prospective teachers, the percentage of this myth was the highest.

Myth III: Mathematics requires a good memory.

Figure 1 indicates that 41% of prospective teachers believed that mathematics involved good memory/rote memorization, while fifty-nine percent of prospective teachers disagreed with this assertion.

Myth IV: There is one best way to do a mathematics problem.

Figure 1 indicates that only 12% of prospective teachers were of the opinion that there was one best way to address the math problem, but notably 88% of prospective teachers were found to be in total disagreement with this statement. This means that the majority of teachers (88%) believed that there could be different alternatives to do math problems.

Myth V: Mathematics is done by working rigorously until the problem is solved.

In response to this myth statement, 47% of prospective teachers believed that mathematics worked rigorously until the problem of mathematics was resolved, but fifty three percent prospective teachers disagreed with this statement.

Myth VI: Men are better in mathematics than women.

Figure 1 above reveals that 9% of prospective teachers believe that men are better off than women in mathematics. Compared to this result, 22% of the participants in another sample believed that the same thing (Frank, 1990).

Myth VII: In mathematics, it is always important to get the answer exactly right.

In response to this myth, 47% of prospective teachers opined that it was always necessary in mathematics to get the answer right. Similar trend are aligned with the findings of the study (Frank, 1990) in which 18% of respondents were of the same opinion.

Myth VIII: Mathematicians do mathematics problems quickly in their heads.

Figure 1 clearly indicates that 53% of prospective teachers held the myth that mathematicians do mathematics problem quickly in their minds, but 47% disagreed.

Myth IX: There is a magic key for doing mathematics problems.

The result revealed that 41% of prospective teachers believed that there was a magic key for doing mathematics. Compared to previous research (Frank, 1990), the present result has shown that more prospective teachers have this myth, which may indicate how this myth has spread over the last 28 years.

Myth X: Mathematics is not creative.

In response to this myth, 6% of prospective teachers thought that mathematics was not creative. The findings support the results obtained by (Frank, 1990) in which 10% of the respondents were of the same view.

Myth XI: For doing a sum, it is bad to count on fingers.

Figure 1 depicts that 12% of prospective teachers thought it was wrong to count on their fingers, but eighty-eight percent of prospective teachers disagreed with the statement. This implies that a significant proportion of teachers thought it was fine to count on fingers for mathematics.

Myth XII: There is only one correct way to solve any mathematics problem.

In response to this myth, it was found that 3% of prospective teachers were sure that there was only one correct way to solve any math problem, but 97% of prospective teachers disagreed with the statement. It suggests that only a very few prospective teachers have held this myth in their heads.

Myth XIII: The mathematics learned in school has little or nothing to do with the real world.

Figure 1 reveals that 9% of prospective teachers assumed that school-learned mathematics had little or nothing to do with the real world, but ninety-one percent disagreed with the argument. This shows that a higher percentage of respondents were free from this myth.

Myth XIV: Mathematics is more difficult than any other subject.

In response to this myth, 9% of prospective teachers believed that math was more difficult than any other subject, but ninety one percent of prospective teachers disagreed with the statement. It indicates that this myth was found in a little proportion of the prospective teachers.

Myth XV: Mathematics is for some bright kids with mathematics genes.

It is evident from the response to this myth, 9% of prospective teachers had confidence in the claim that mathematics was for some bright children with mathematics genes, but ninety-one per cent of prospective teachers disagreed with the statement.

The fifteen identified mathematics myths held by prospective teachers are shown in decreasing order in Figure 2.

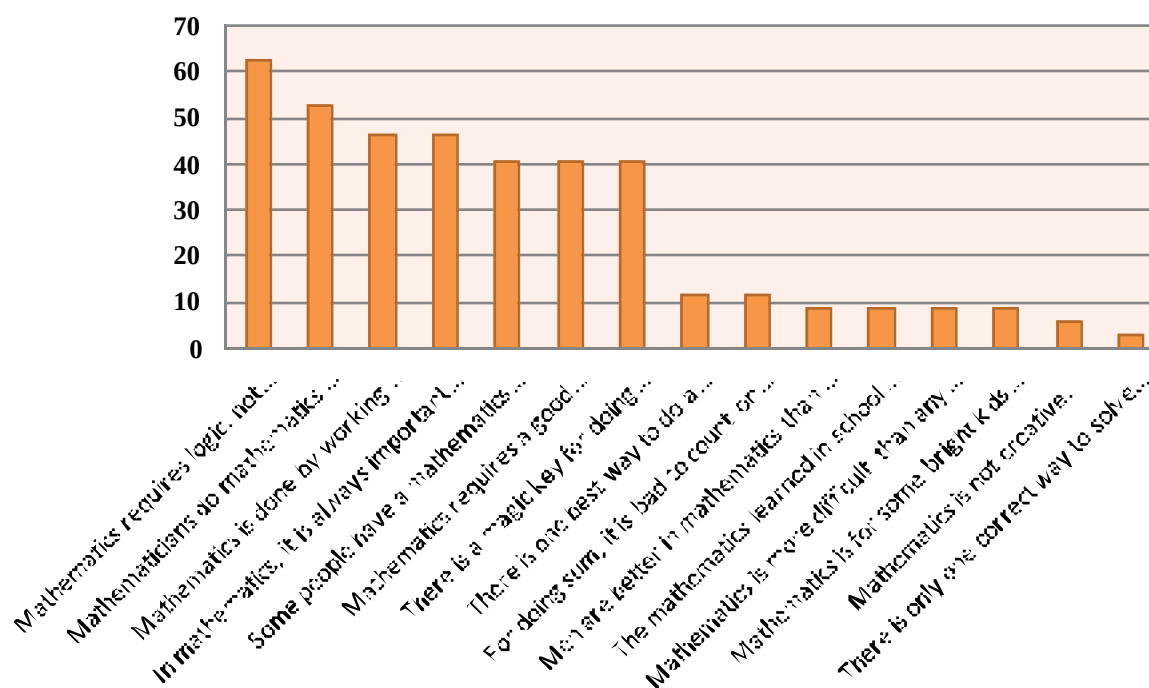


Figure 2: Myth about mathematics held by prospective teachers (in percentage)

3.4.Sources of Myths as Perceived by Prospective Teachers

The final objective of the research was to discover the sources of myth about mathematics held among prospective teachers. For this, a few participants were interviewed; their responses revealed four major sources of myth: personal experience, culture/society, friend, and teachers. Many prospective teachers (90%) stated that they had these myths from their own experience. One of the responded said: “I have seen that there is no need for mathematics to do creative work in society”.

A few prospective teachers (3%) said that they heard some of the myths from their mathematics teachers. Some prospective teachers (3%) stated that they had some of the myths from their society and friends respectively. From the analysis it was revealed that one's own experience played important role in possessing and conveying myths.

5. Conclusion

A large part of the prospective teachers conveyed myth about mathematics. The widespread myths among the prospective teachers were: 'Mathematics requires logic, not intuition,' 'Mathematicians do mathematics problems quickly in their heads', 'Mathematics is done by working rigorously until the problem is solved', 'In mathematics, it is always important to get the answer exactly right', 'Some people have a mathematics mind and some don't', 'Mathematics requires a good memory', and, 'There is a magic key for doing mathematics problems'. The proportion of the myth related to gender, 'Men are better in mathematics than women' was low. Regarding the sources of the myths, about ninety percent of prospective teachers conveyed that they got them from their own personal experience.

In order to provide quality education at school, teacher education programmes must be sufficiently effective. The prospective teachers must be good at content, pedagogy and technology knowledge, and free from various myths related to the subject and pedagogy. They should use fun and humour in their class (Haider & Jalal, 2018). Although there were a number of limitations to this study due to the small sample size, etc. Nevertheless, the results provide some insights into the prospective teachers' myth about mathematics. In light of findings, it can be suggested that the prospective mathematics teachers need to be aware of the myth about mathematics. Furthermore, mathematics teacher educators must be aware that the prospective teachers bring a number of myths about mathematics to the classroom. The debunking of the myths is essential. If these prospective teachers are not aware of the myths about the mathematics, the myths will pass on to the next generation; thus a myth cycle or fallacy loop would be continued. According to Bain (1947), "the myth seldom dies a decent and definitive death, however. In subtle forms, it lingers on to confuse men's minds and confound their management of practical affairs" (p. 16). Therefore, debunking a myth requires techniques such as providing ample evidence, sufficient facts, explanations, etc.

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