Girl Students in Mathematics at Bachelor level Colleges of Kathmandu Valley, Nepal: Some Problems and Prospects

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Abstract

This Paper is based on the study of girl students studying at Bachelor level in mathematics in six reputed educational institutes situated in Kathmandu Valley. The Paper is guided by three objectives – to examine the historical trend of girl students offering mathematics at the Bachelor level, to examine the possibility of increasing the enrollment of these students, and to identify policy instruments that can help increase their participation. Low number of girl students, low number of female teachers, limited availability of resources and equipment are among the important features that characterize the Bachelor level education in Mathematics. The Paper also enumerates some policy instruments that can assure the future career prospects of girl students studying mathematics.

Introduction

Teaching and studying mathematics in Nepal has a long history. Mathematics as a subject is taught in schools and colleges throughout Nepal and do form a part of curricula at all levels.

However, the number of girl students in mathematics at schools and colleges particularly at higher levels are very few except in cases where the subject is taught as a compulsory one. Still, a matter of concern is the erratic trend of the growth of girl students as a percentage of total Mathematics students. The average percentage of girl mathematics students in the total during the period 2012/13 – 2016/17 is only 13.53 percent. This indicates that the number of girl students in mathematics is still low as compared to the total number of students which has its impact not only on the number of girl students willing to opt for mathematics for higher studies but also on those who seek to build a career in Science, Technology, Engineering, Innovation and other areas where mathematics is considered a prerequisite.

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Mathematics impacts the life of every member of the Nepalese society as elsewhere including women. Women in Nepal constitute around 51 per cent of the total population. They are involved in various economic pursuits. They can change the quality of life in the family with their education, enhanced analytical skills and leadership quality. These are among the major reasons for expanding their education in the society and in the country also. Nepal's overall literacy rate (above 5 years of age 2011) is 65.9 percent and the men and women literacy rates are 75.1 and 57.4 respectively (Statistical Year Book of Nepal 2013). Women literacy rate is already low and still lower is the rate aspiring for a career in mathematics among girl students.

The present Paper is based on the study of girl students pursuing Bachelor level courses in Arts and Science faculties only, although the author recognizes that the involvement of students/teachers at pre/post-graduate levels is also very significant and should be an area of studies in the context of expanding the teaching and study of mathematics.

The reasons behind the selection of Bachelor level girl students as an area of critical concern for study have emerged from the fact that most often girl students discontinue their studies after they graduate, largely because several of them enter into conjugal life which prevents them from pursuing university studies and beyond, the environment in the household is not supportive for some girl prospective students, financial difficulties to support studies, search for employment and eventually entering into jobs and so on. The number of girl students at Master's level and beyond is relatively low. The scope of present Paper is limited in the sense that the present Paper is confined to mathematics only at Bachelor's level.

One of the serious limitations in the study of this nature emerges from the lack of disaggregate analysis largely because of the fact that it is difficult to get disaggregate information on girl students in mathematics, the age structure, their economic status, the status of employment of those who graduated with mathematics as a major subject and so on. The Paper draws conclusions based on an analysis of a five year period of six prominent educational institutes operating in the Valley.

The author feels that policy recommendations are going to be helpful to identify issues that are critical to attracting girl students in Mathematics at Bachelor level and recommend policy measures for further reform.

By far, very little study has been conducted in the area of girl involvement in mathematics in Nepal. The present Paper draws heavily from those past research studies and other works, and based on these and the author's own teaching and research experiences, the present Paper provides insights on those issues that are directly relevant to the understanding of the objectives enumerated below.

Objectives of the Paper

The Paper has three objectives.

i. To examine the historical trend of girl students offering mathematics at the Bachelor level as their elective subject.
ii. To examine the possibility of increasing the enrollment of girl students in mathematics at this level and
iii. To identify policy instruments that can make a difference in reversing the past trends and to assure the prospective community that mathematics holds a bright future in the days ahead.

Materials and Methods

This Paper depends on information drawn from both primary and secondary sources. Primary sources of information constitute inputs from girl students studying at Bachelor level in mathematics in six reputed educational institutes situated in the Kathmandu Valley. All these institutes are well established ones involved in teaching mathematics. The participants are all regular and bona fide students. All the inputs received were reviewed carefully so as to make sure that there is a clarity and consistency in the inputs received. Apart from this, desk research was also undertaken, based on published materials in technical and professional journals, books and other teaching materials. Both sources complemented and supplemented each other. This has helped reflect ground reality in the Paper.

Results and Findings

Mathematics is assuming increasing importance in our daily lives. Teaching and learning mathematics by using e-tools and IT is certain to get prominence in the days to come. A rapid development in information technology has enlarged opportunities for the application of mathematical knowledge in many professions and in business decisions. Hence, it is

important to understand the past trend, problems and prospects of studying and teaching mathematics.

There are several educational institutes in the country that impart education on mathematics. Tribhuvan University (TU), the oldest one, offers a large number of diverse undergraduate (Bachelor) and graduate programs (Master, M. Phil. and Ph. D.) through five technical institutes, four faculties, sixty constituent campuses and 1,084 affiliated campuses. A Total of 436,781 students was enrolled in the constituent and affiliated campuses under TU in the academic year 2014/15. Of the total, around 38.89 percent (169,865) students are enrolled in the constituent campuses and remaining 61.11 percent (266,916) are in the affiliated campuses. Overall, 44 percent of them are girl students in the academic year 2014/15. Out of Total students, 85 percent enrolled in non-technical education and 15 percent in technical education respectively (Pokharel, http:/tribhuvan – university. edu. np/ planning – division/n. d.). Hence, the number of girl students pursuing technical education in Nepal is relatively low.

In course of the present study, attempts were made to collect information from six educational institutes where Bachelor level courses are being taught. These are currently the prominent institutions and are best known in the country. These are (i). Amrit Science College, (ii). Bhaktapur Science Campus, (iii). Khowpa College, (iv). Padma Kanya Multiple Campus, (v). Saraswati Multiple Campus and (vi). Tri-Chandra Multiple Campus.

The following table (Table 1) highlights the trend of mathematics students in these institutes. The table reiterates once again that the number of students enrolled in mathematics is relatively low – only 1,064 during the five years period (2012/13 -2016/17). Out of this, the Total percentage of girl students is far meager – around 13.53 percent (144) only during the five year period whereas boys constitute overwhelming 86.46 percent (920) of the total.

Table 1 also highlights annual trend of boys and girl students studying mathematics. One positive aspect is that the number of girl students in mathematics has been on the increase. It has increased from 8. 47 percent in 2012/13 to 18.91 percent in 2016/17.

Table 1: Total Number of Students Studying Mathematics at the Bachelor level (2012/13-2016/17)

S. N.	Academic Years	Total students (both boys and girls)		Total (boys Students)		Total (Girl students)		Girl students as % of Total students
		No.	% Distribution	No.	% Distribution	No.	% Distribution	
1.	2012/13	236	22.18	216	23.48	20	13.89	8. 47
2.	2013/14	191	17.95	168	18.26	23	15.97	12.04
3.	2014/15	242	22.75	201	21.85	41	28. 47	16.94
4.	2015 /16	194	18.23	172	18.69	22	15.28	11.34
5.	2016/17	201	18.89	163	17.72	38	26.39	18.91
	Total	1064	100.00	920	100.00	144	100.00	13.53

Source: Information received from respective institutes.
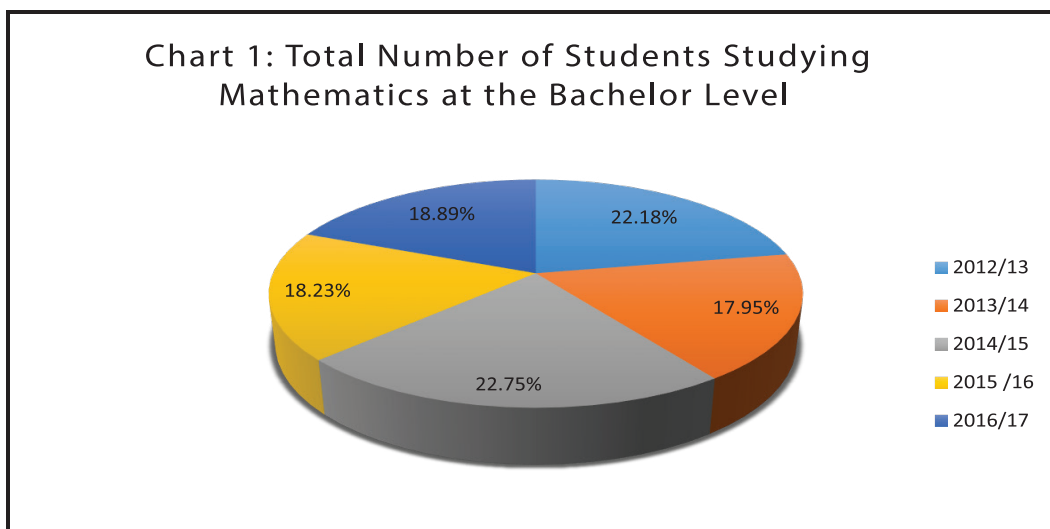
The following table (table 2) indicates that Amrit Science Campus has admitted the highest number of girl students in mathematics and hence contributed a lot in terms of imparting mathematics knowledge to girl students (37.50 percent), followed by Padma Kanya Campus (29.16 percent) and Khowpa College (12.50 percent), Tri-Chandra and Bhaktapur campus(each 10.42 percent). No girl student was enrolled in mathematics in Saraswati Campus during the period, indicating that Saraswati Campus needs to be encouraged to enroll girl students in mathematics in future.

Padma Kanya Multiple Campus (PKMC) has a glorious history of initiating education among girl students. The Campus has been teaching several subjects including mathematics. Since 1951, hundreds of students have graduated from the Campus in different areas, and the prospect exists for the Campus for increasing the number of girl students in mathematics as it is the only girl campus situated at the heart of the city.
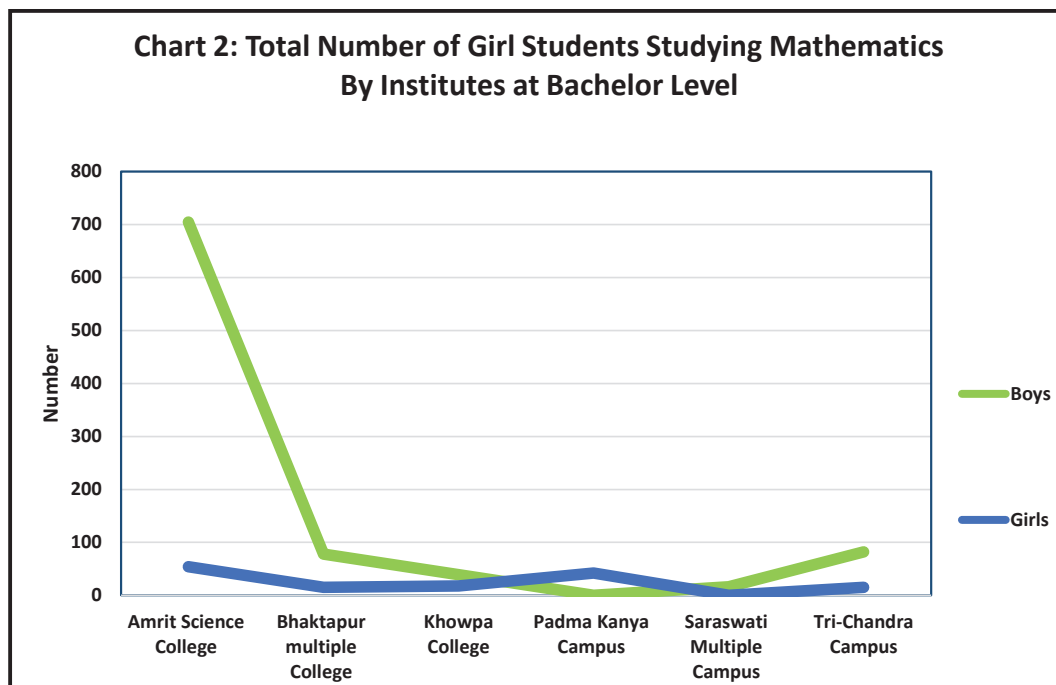
Table 2 also reveals the relative position of each of the six educational institutes under review in terms of the number of girl students in mathematics and their relative contribution in the total. The table also indicates the institutes where more effort is relatively needed to enhance the enrollment of girl students in expanding the knowledge of mathematics among girl students through enhanced enrollment.

Table 2: Total Number of Girl Students Studying Mathematics (2012/13-2016/17) By Institutes at Bachelor level

S. No.	Institutions	Total Number of Students Offering Math					
		Total	% Distribution	Boys	% Distribution	Girls	% Distribution
1.	Amrit Science College	759	71.33	705	76.63	54	37.50
2.	Bhaktapur multiple College	93	8.74	78	8. 48	15	10.42
3.	Khowpa College	57	5.36	39	4.24	18	12.50
4.	Padma Kanya Campus*	42	3.95	-	-	42	29.16
5.	Saraswati Multiple Campus	16	1.50	16	1.74	None	-
6.	Tri-Chandra Campus**	97	9.12	82	8.91	15	10.42
	Total	1064	100.00	920	100.00	144	100.00

* It is a girls campus and hence no boys students
** Figures are not available for 2012/13 and 2013/14.

Chart 2: Total Number of Girl Students Studying Mathematics By Institutes at Bachelor Level
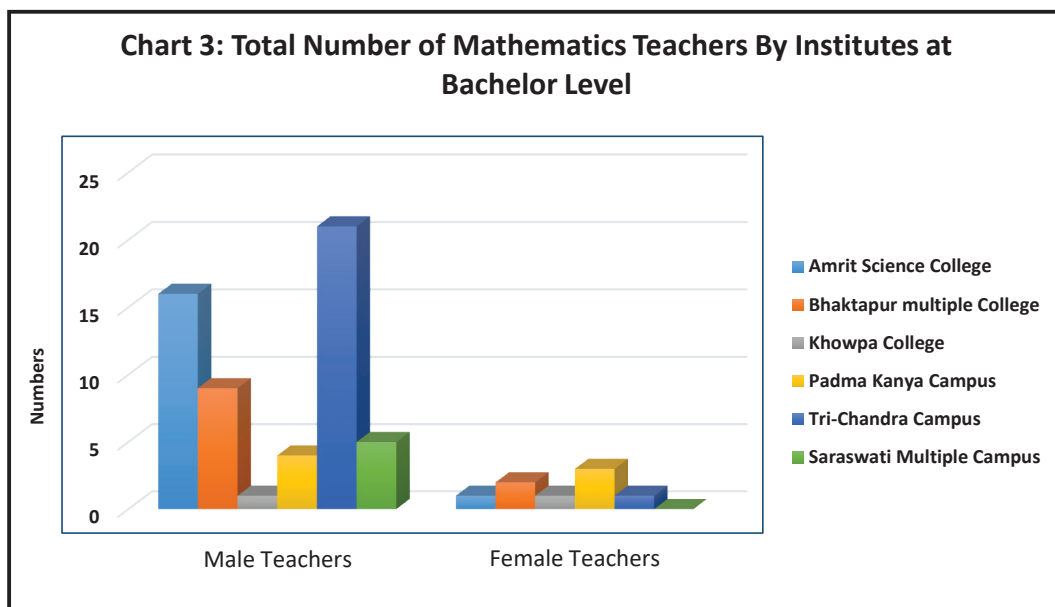

Regarding the distribution of mathematics teachers in each of these institutes, the following table (Table 3) reveals the situation. During the period under review, altogether 64 mathematics teachers are providing services in these institutes out of which only eight (12.50 percent) are female teachers. The female teacher-students ratio is 18 (144/8) while the same for the male is 16.43 only (920/56). This is one of the serious factors impeding the enrollment of girl students in mathematics in various institutes. In one institute, there was not a single female mathematics teacher as against five male mathematics teacher. In each of three institutes, there was only one female teacher while in other two institutes, two and three teachers were reported to have been providing services. Indeed, this can be considered a pathetic situation with little or no initiative for the institutes to recruit more mathematics teachers. This partly explains why only 13.53 percent girl students out of the total are studying mathematics in these institutes.
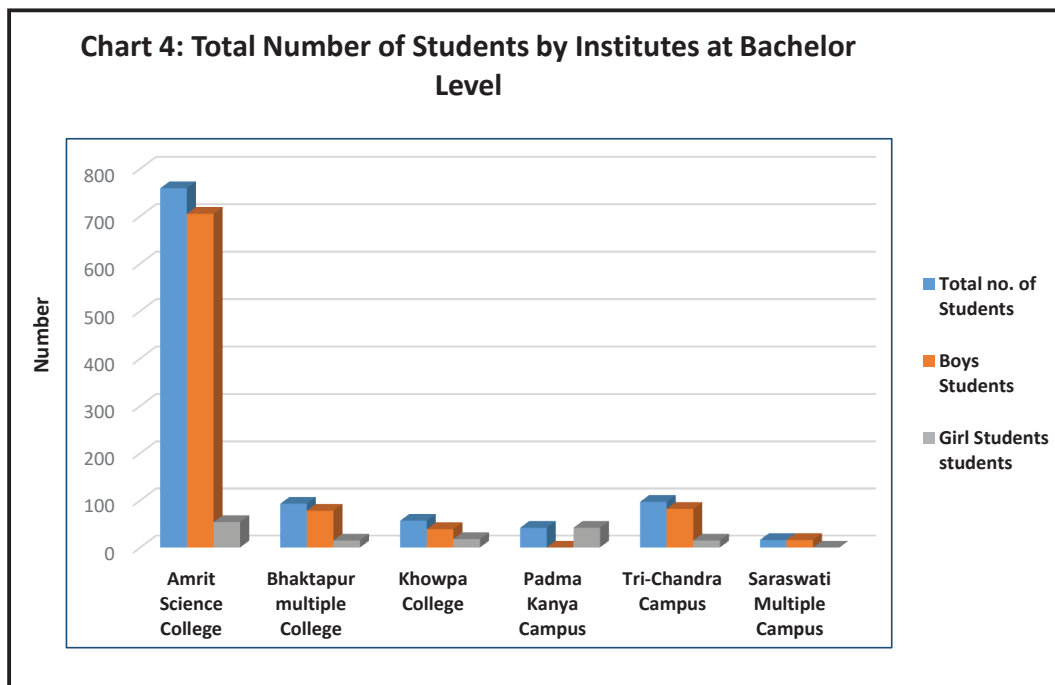
Table 3. Total Number of Students and Mathematics Teachers (2012/13-2016/17) By Institutes at Bachelor level

S. No.	Institutions	Number of Teachers and Students in Mathematics					
		Total no. of students	Boys students	Girl students	Total no. of Mathematics Teacher	Male Teachers	Female Teachers
1.	Amrit Science College	759	705	54 (7.65)	17	16	1 (5.89)
2.	Bhaktapur multiple College	93	78	15(16.13)	11	9	2 (18.18)
3.	Khowpa College	57	39	18(31.58)	2	1	1(50.00)
4.	Padma Kanya Campus*	42	-	42 (100.00)	7	4	3(42.85)
5.	Tri-Chandra Campus**	97	82	15 (15.46)	22	21	1(4.55)
6.	Saraswati Multiple Campus	16	16	None (-)	5	5	0(-)
	Total	1064	920	144 (13.53)	64	56	8 (12.50)

Source: Information from respective institutions.
Note: Figures in parenthesis are the percentage of the Total.

Chart 3: Total Number of Mathematics Teachers By Institutes at Bachelor Level

Chart 4: Total Number of Students by Institutes at Bachelor Level

Discussions

The above trend analysis gives rise to many issues that merit serious consideration. A lot of discussions has also surfaced as a part of discovering measures to address these issues. A number of reasons exists for the low students/teachers participation in mathematics courses in these institutes. However, the following major points can be briefly discussed:

i.   **Low number of girl students :** The number of students studying mathematics is comparatively low, and exhibit an erratic trend, although in recent years, the trend is one of increasing. Available information has indicated that Women are far less likely to opt for mathematics at the Bachelor's level, only to decline further in Master's levels and beyond. This trend has been confirmed by other similar studies in case of Nepal and in other countries also (UNESCO, 2015).

ii. **Low number of female teachers in mathematics:** The number of teachers in the field of mathematics is still meager in comparison to that in other subjects. An increase in the number of female teachers

might likely induce the girl to opt for mathematics. The possibility of increasing interaction between the teachers and the students can be considered as a positive factor to build self- confidence among the girl students. This is likely to instill in them a sense of confidence that they can also do better in the field of mathematics as their male counterpart.

iii. **Limited availability of financial resources:** Theissue of financial resources is crucial in any institutes largely because availability of financial resources for the teaching of mathematics is limited. In addition, it is difficult to find out how much of total financial resources are being earmarked for teaching mathematics in above colleges/campuses. Still scanty is the information on how much earmarked financial resources have been used for teaching and imparting mathematics education in these institutes. The UNESCO rightly observes that "The increased resources for students to apply their knowledge in practice, could help stimulate interest among female students to potentially pursue this discipline in further study"(UNESCO, 2015). The gap between the demand for and the availability of financial resources and the Utilization of whatever resources are available continue to remain a critical constraint in the country.

iv. **Notion of male dominated field:** "Mathematics is seen as a male-dominated field and it has been an uphill battle for women trying to break into the field". (Huff,2011) writes that "For years, Women in the mathematics field have been overlooked, underappreciated and harshly judged based on their gender". Many girl students still consider mathematics as a male domain (40.0 percent). They pointed out that they had to shoulder family responsibilities that inhibit them to devote much time in the study (30.0 percent) despite their desire to do so(Shakya,2018).

v. **Out of comfort zone:** "Some girl students consider mathematics as a technical subject and hence it is out of their "comfort zone". Several of them reported that they are not interested to pursue mathematics courses because of its technical nature, and women mathematicians have made less progress in their career (Shakya, 2018). This notion still

continues to characterize and dominate the prospective students of mathematics in the country.

vi. **A technical subject:** Mathematics as a subject is considered rather difficult, monotonous, and technical. Also, mathematics, particularly at a higher level is deemed as a dry subject with limited relevance to issues of daily lives.

vii. **No future career:** Potential mathematics students view that there are no prospects for future career except in teaching and training because the expansion of demand for jobs in the Labor market in this field is rather slow or limited.

viii. **A Broad array of issues involved**: (Panthi and Belbase, 2017) while discussing major issues of mathematics teaching and learning in Nepal observe that a broad array of issues that include teaching approach, social, cultural, political and technology need to be addressed to improve teaching and learning mathematics. Teaching and learning mathematics are beset with several problems. Some of these are serious and demand immediate action from the authorities while some other problems can wait for some time before the policy response can be devised and executed.

Conclusions

Mathematics is a growing subject and with the passage of time, it will continue to remain so both in terms of scope and application. The increasing application of information and communication technology can be expected to be an integral part of mathematics study. For this, the mathematics community including the Campus has to be thinking of creating infrastructure that can support and absorb such developments of ICT within the domain of mathematics.

Now that teaching and learning practices are constantly changing and so are the interests of the teachers and students alike. The teaching and learning environment need to cope with such changes, based on the identification of how the teachings of mathematics can be made most effective, how students can be guided to learn mathematics, how can the creativity of the students be used to learn and expand their knowledge on mathematics, to

what extent mathematical concepts can be used in real life are some of the pertinent questions that eventually determine the desire and commitment of girl students to go for mathematics study .

These are no easy tasks in view of differing obstacles to attracting more girls and women to mathematics. Nonetheless, the dearth of research and understanding and the significant need for increasing numbers of girls and women in mathematics justifies a thorough as well as deep investigation into this area. This is an area that deserves a national priority in the overall educational development of the country.

Implications

The issues discussed have several implications on expanding teachings and learning mathematics. Three important issues that have implications on the trend, future prospects and policy instruments that follow from the above discussions drive home the following issues: (i) The trend of girls students in mathematics is low but increasing, (ii) there is a possibility of increasing the number of girl students in mathematics and (iii) policy instruments need to be devised and implemented to bring about changes in the situation depicted by historical trends. Nepal should consider the magnitude of untapped potential and talent at a time in which mathematics is destined to becoming more and more important in the days to come. These issues discussed above provide the directions where the future efforts need to be designed, backed by effective, and relevant policy instruments. Some of these can be highlighted as follows:

i.   A long term vision on the impact of enhancement in knowledge in mathematics will go a long way to give inspirations to the teachers and students alike of a bright and promising career for which the opportunities are waiting for them. The vision will provide an assurance to the teachers, parents and the students that their efforts and investments will certainly generate positive gains and will not go in vain.

ii. A comprehensive human resource development plan in the field of mathematics backed by appropriate policy instruments including financial resource allocation will be helpful. Targeted intervention measures within the framework of the plan can help increase girl participation in the expansion of mathematics education in the country.

iii.   An education policy that promotes, among others, parental education to encourage girl students to join mathematics classes needs to be designed and put into operation.

iv.   Training programs for the teachers for improving the quality of education including mathematics, providing congenial environment, including teaching guides and instruments, can be considered to be useful. The training could gear towards dispelling the notion that mathematics is dry and only the male can achieve dexterity in understanding and solving complex problems.

v.   It has to be emphasized that any policy formulation for increasing the motivation and dedication of students and teachers requires a strong and comprehensive data base so that one can monitor or assess the development taking place in this field. But, the present status of statistical base relating to the study and research works of mathematics remains an area to be improved.

vi.   Establishment of a research wing in each of these institutes can help develop environment and change opinion in favor of expansion of teaching and studying mathematics in these institutes. Such a wing can also come with measures that can motivate and attract the prospective girl students/teachers to join mathematics classes in increasing number.

With the increase in the number of enrollment of girl students in higher education, there is apparently a good prospect for increasing the number of girl students choosing career in mathematics. The prospects can be utilized through the proactive and consistent policy responses along with certain innovative intervention measures.

i.   Expand collaborative pedagogical strategies that allow students to work together on projects or assignments that can help increase interest in mathematics as it reduces anxiety among students and provides them with an opportunity to reflect on and digest new materials (Tobias, 1989).

ii.   Generating interest and improving performance in mathematics are possible if students are taught how to study and apply needed skills in mathematics. As part of these interventions, demonstrating students how to make connections between previous experiences and new materials are likely to create congenial environment for bringing about this kind of change (Tobias, 1989).

iii. Sponsoring events which are targeted at girl students in high school may encourage enrollment in mathematics at higher classes. The event provides hands-on activities and interactive labs as well as opportunities to network with women who have graduated with a degree in mathematics, allowing students to form more long-term mentoring relationships.

iv. Gender-based stereotypes have made it socially acceptable for females to state that they are not good at mathematics or that they ''can't do mathematics." Parents and teachers need to be careful to do away with these stereotypes by not allowing females to make disparaging comments in relation to mathematics and their mathematics skills as it further negates interest for the individual and among female peers (Beilock et al., 2010).

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