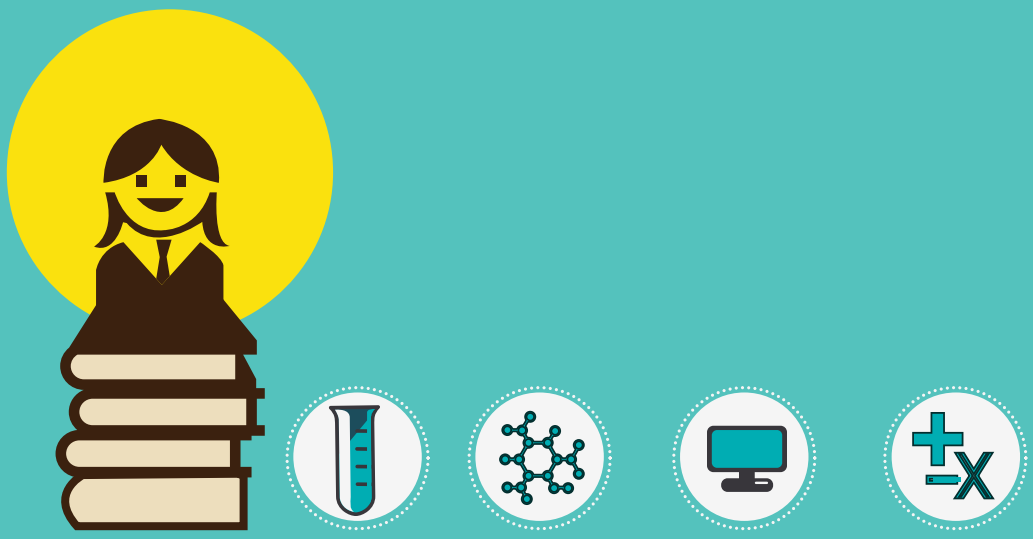
Why don't girls opt for STEM (Science, Technology, Engineering, Maths)?:
A Gendered Enquiry

A Study by Feminist Approach toTechnology

Supported by Google RISE
Global Fund for Women
Vikas Society for People's Development

FAT
Feminist Approach to Technology



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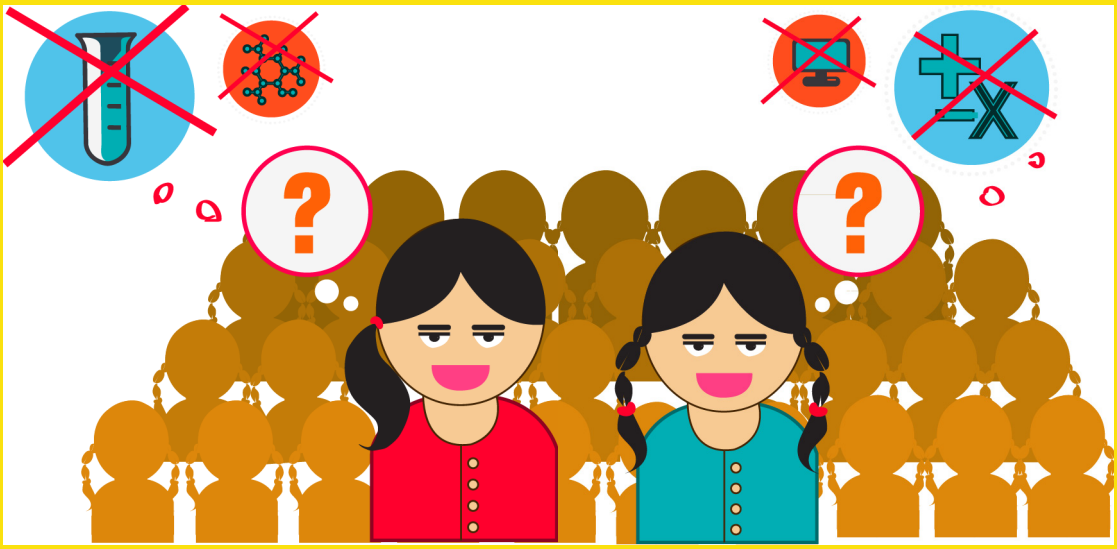
WHY DON'T GIRLS OPT FOR STEM SUBJECTS?:

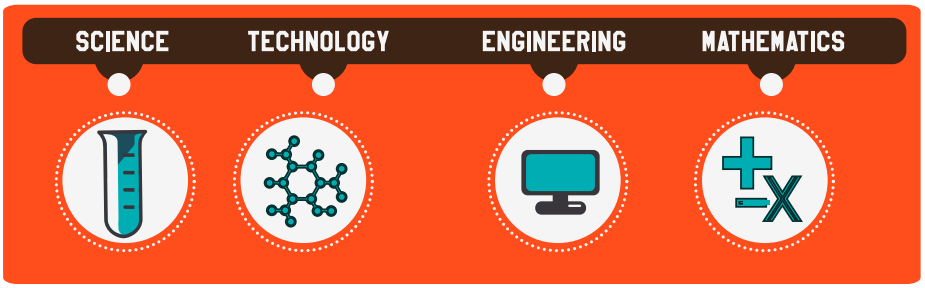
A GENDERED ENQUIRY ▶

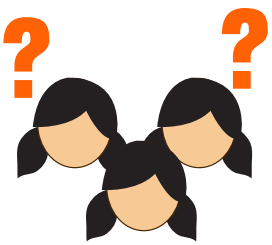


WHY DON'T GIRLS OPT FOR STEM SUBJECTS?: A GENDERED ENQUIRY

This research study has been undertaken, from February 2013 to February 2014, by **Feminist Approach to Technology (FAT), a not-for-profit organization based in Delhi, with support from Google Inc, Global Fund for Women and Vikas Society for People's Development.** FAT is a recipient of the Google RISE Award instituted by Google to offer support to organizations working around the globe to inspire the next generation of computer scientists – especially those that reach girls, under-represented minorities and students who face socio-economic barriers.

FAT envisions a world where the usage, creation, access and innovation of technology is gender neutral.
This is a world where all women have equal opportunities to learn, use and create technology, irrespective of their academic background, economic status or geographical location: an environment where women are not intimidated by new technologies but rather develop an open mind to experiment with and benefit from them. To create this environment, a space needs to be provided where their interaction with science and technology is friendly and enabled. Thus, schools, teachers and institutional infrastructure and how girls and women get to be involved is of utmost importance. Therefore, to understand these interactions we looked at how girls view, perceive and understand Science, Technology, Engineering and Mathematics (STEM) subjects through internal (their attitudes and perceptions) and external "(parents, teachers, infrastructural and institutional)" factors.





* *This is a world where all women have equal opportunities to learn, use and create technology, irrespective of their academic background, economic status or geographical location*

Why is STEM important for women?

* *It has been realized world over that STEM provides for better opportunities as it's a field that innovates something new every day and also has implications on our lives.*

* *The people involved in these fields make a lot of decisions based on societal needs. STEM is also something that influences our future, as we are living in a technology ridden society (Poineers).*

This, therefore, requires us to keep ourselves in tandem with it, so as not to fall behind and constantly work towards bridging the digital gap. It's true that the digital gap exists between different countries, classes, castes, ethnicities and race. This is because STEM is neither value- nor identity- neutral which, in turn, has pushed women further on to the margins, in a new world order. It continues to perpetuate gender stereotypes on roles and responsibilities of women, by labeling women as illogical (Feminism, 2013). Thus, feminists concerned with science and technology in feminism are working towards bridging the gender gap and reducing the knowledge deprivation in the digital world.

Women are important in STEM fields because, "attracting and retaining more women in Science, Technology, Engineering and Mathematics workforce will maximize innovation, creativity and competitiveness (Feminism, 2013)' which will place women on a level-playing field with men. In a digital society this will provide women with better pay scales as, in STEM jobs, the income is higher when compared to jobs in other fields (where women are pushed to work). It's essential for women to be part of STEM because, "scientists and engineers are working to solve some of the most difficult challenges of our time, engineers design tools, technology and things we use daily. When women are not involved, as scientists and engineers, their experiences, needs and desires that are unique are overlooked (Association of American Colleges and Universities 1999)."

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Exploring, experiencing and understanding the gendered nature of STEM and the urgency of women to get involved with it, FAT conducted a research study with a group of adolescent girls from underprivileged background, studying mostly in government schools.

The research question that the study attempted to answer was:

What were the reasons for girls from an underprivileged background being dissuaded in choosing STEM courses – especially Science and Maths- within an Indian context?

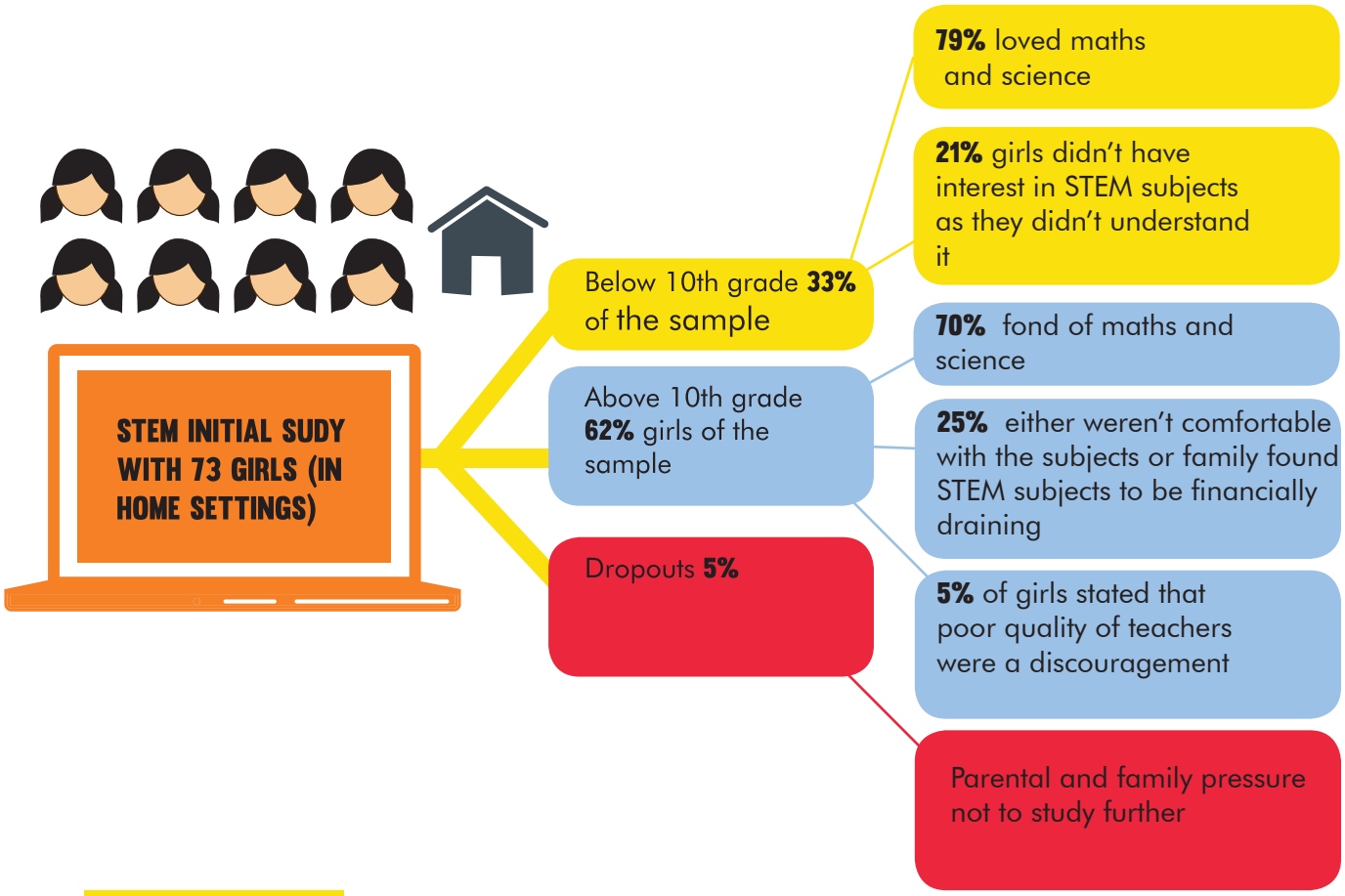
BACKGROUND OF THE RESEARCH

The formation of the research question lies in the experiences FAT has gathered while working with the young women aged 10-25 from economically marginalized communities residing in the slum settlements of South Delhi, India. FAT runs a Technical Center for these girls where regular classes are held on basic computer skills, camera skills, filmmaking skills, communication skills, as well as workshops on gender, feminism, sexuality, social issues and rights. While working with girls in this community, FAT realized that they tend to have a preconceived notion that STEM fields and courses are beyond their caliber and, more pertinently, not of their interest. When further examined, it emerged that girls are especially disinclined towards choosing STEM subjects in secondary and higher-secondary levels. This has been the scenario even in cases where they have been doing well in these subjects, in primary classes, for instance. Also, a large section of them drop out or take up diploma or vocational courses to enhance their employability as against continuing with formal education at school or college. In fact, familial pressure has been cited as one of the biggest reasons for such decisions. Much of this was shared by girls during the years of working with this group at the Tech Center, and this propelled FAT to examine this phenomenon further in the form of a research since it was influencing their mandate strongly.

A small pilot study was conducted, in October 2012, to capture the attitudes of these girls towards STEM subjects and examine the educational environment that included support from educational institutions and family. The idea was to use the information that emerged from the study to intervene at an individual level through the Center with the specific aim of encouraging interest in STEM among girls.

The pilot study surfaced girls' interest in STEM subjects. While some are extremely fond of Science and Maths–and have received support from the family–they are not able to pursue it because of limitation and restrictions at home that has emerged out of deep-rooted patriarchy. There is an assumption that boys are bread earners and hence providing them high quality education in STEM subjects is going to be more advantageous for the family than the girl, as she is meant to only do household chores.

A plethora of reasons emerged in the study that may have been behind the disinclination among girls to opt for STEM courses and it needed to be further examined. It was necessary to find out whether this was a reflection of a larger population than the 73 girls who were part of the initial study. Hence, this research study was undertaken in-given time period.



Feminism and STEM

Feminism isn't monolithic. This has been realized by feminists all across the globe but all feminisms recognize, "women have historically been devalued and denied full quality. Feminism therefore provokes questions about the undeserved power differentials in society" (Association of American Colleges and Universities, 1999). This holds true for all spaces where women exist. The power relations between a man and a woman have been pre-defined because of the idea of "universal gender roles." This has also made many believe that women are not suited for science and technology and, similarly, feminist studies and women's studies have ignored science and technology as a pertinent subject of exploration (Faulkner, 2000).This has started to change in recent times as more women are entering and taking up science and technology as academic and professional careers. As a result, there is a need to understand science from a feminist lens as, "in applying feminist analyses to scientific ideas and practices, feminism sees science, like all spheres of intellectual activity, as conditioned by historical circumstances, societal beliefs, and accepted norms(Association of American Colleges and Universities, 1999)."

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This will help in critically looking at science and technology not as a non-gendered space but a space that needs to acknowledge all genders. This is to say that, "feminist analysis has helped us understand why women have not participated fully in scientific communities and why many still feel unwelcome when they do. It also articulates the reasons why it is advantageous to science that there be a diversity of people and perspective in the scientific community (Association of American Colleges and Universities, 1999)." For this to happen, it is important to encourage girls to take up STEM subjects in schools and colleges; this will also reduce the existing gender gap in these fields.

The gender gap within the STEM courses and fields has been an area of special interest for many feminist researchers interested in science and technology studies across the world. Wendy Faulkner states that, "feminist scholarship within the field of technology studies, or feminist technology studies, is more ambivalent and sees technology as socially constructed or co-produced, alongside gender (Faulkner, 2000)". FAT has built on this premise of technology and women and therefore, works towards providing and enabling spaces to young girls and women to create, innovate and use technology for their purpose and benefit. In this regard, when FAT conducted a baseline literature review, it found that in the Indian context, there have been very few studies done in this field. Thus, one of the objectives of this study was to build an understanding among those interested within the field regarding gendered experience within STEM courses. For this reason, this study was primarily exploratory in nature, digging deeper into the factors that were contributing to the situation.

Weinburgh (Weinburgh 1995) conducted a meta-analysis of the literature on gender differences in students' attitudes towards science and found that boys displayed more positive attitudes towards science and that attitude is highly correlated to scientific achievement. It is not just in India, but a world-wide phenomenon that girls are under-represented in STEM courses and fields, as they hold less than 25% of the jobs in the field (Beede, Julian, & et.al, 2011). Additionally India ranks lowest in the countries that provides women opportunities in science and technology innovation (Elan, 2012). However, it has been observed that in the schools there is a subtle shift across gender in the choices of the academic courses.This becomes marked with age, especially during post higher secondary. This is especially relevant in the Indian educational system since this is the point at which the choice is made as to which stream (Science, Business or Humanities) to pursue for further studies. More boys tend to choose sciences in comparison to girls, often citing interest and abilities as their reason.

METHODOLOGY

Methodology is the systematic and theoretical analysis of the methods applied to a field of study. It comprises of a theoretical analysis of the body of methods and principles associated with a branch of knowledge. In this study, various methodologies were used like—a comparative analysis methodology was used to understand the difference in performance of girls and boys in the same field of education, focussed group discussions (FGDs) were used to capture the qualitative aspect of the study and survey method was used to collect responses by the participants to understand their individual experiences. These methodologies and their importance are further elucidated in the discussion.

The first step of the study was to analyze the results in government schools between girls' and boys' performances across different classes (6th – 9th) to identify a pattern, if any. The results were obtained from selected government schools which were permitted by the Education board. Of the grades that were obtained, a tally was made. This was followed by the percentages, which was then used to make the comparison. It is to be noted that the number of boys and girls in the sample could not be controlled as the student population was different in different schools and classes.

The second step of the study was to create a questionnaire for the FGDs. FGDs are collective conversations that may be small or large, directed or non-directed. In this case, the researchers chose to use small and directed FGDs owing to the participants involved and their age and individual understanding. The questions used in the FGD were developed on the basis of the review of literature, following which testing was done at FAT's Tech Center. The questions were further refined on the basis of experimental FGD.

The samples for FGDs were five government schools and one private school with 10 students in each class from 6th-10th, totalling up to 300 students. A total of thirty FGDs were conducted. Each class FGD lasted for an hour with the questions focused around what were the factors that kept them interested in STEM courses and what made it challenging for them. From the FGDs' transcripts, predominant responses were later categorized across three themes: 1. Personal factors, 2. Social/Familial factors, and 3. Institution related factors. Of these responses, the most prominent were then used in developing the questionnaire for the survey to take back to the same classes and schools.

The survey questionnaire was developed incorporating the relevant questions from Google form as well as emergent questions from FGDs. There was a mix of open ended, closed ended and multiple choice questions with 19 questions. The questionnaire was divided into Individual, Institutional Infrastructural and Familial Factors that influences students' performances in STEM courses. The survey was undertaken with 2615 students.

SPSS was used to generate means and percentages across different factors in the questionnaires. The ones that were found to be statistically significant were then taken up in the discussions.

CHALLENGES

The biggest challenge during the study was that it wasn't conducted with one unified sample kept varying because it engaged with various schools and each of these schools had a diverse demography. The sampling done here couldn't work with a simple analysis method and therefore we had to collate the data, in the best possible way, to get an overall understanding of girls involved in STEM education. Therefore, the statistical data in the report has collated many different samples to bring out a cumulative percentage of the data that was collected during the study. Thus, the percentage indicated might be </> 100% for the number of girls have been different in each analysis.

There were other challenges that emerged during the study especially with respect to the target audience for this study. Since government schools were the target, there was challenge in getting permission from the government authorities to conduct the study. This impacted the selection of the participants as truly random sample could not be taken. The researchers had to resort to convenience sample.

There were many extraneous factors that influence the choice of taking up STEM courses as in many government schools where the marginalized girls study, there is no availability of the STEM courses and those who are interested then need to shift their school where the financial status of the family becomes important.

With respect to the administration of FGDs and survey, understanding of the participants of what was required of them was difficult. The researchers had to probe and be directive in seeking responses from the participants.

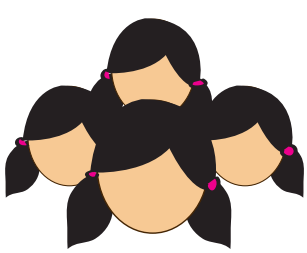
The anchor of the program leaving in the initial stage of the research was a challenge and lack of experience of the research team impacted the research process as it slowed the whole process and also may have impacted the depth of the FGDs.

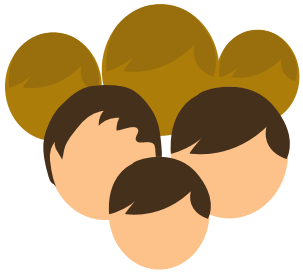
GIRLS' PERFORMANCE IN STEM THROUGH RESULTS ANALYSIS

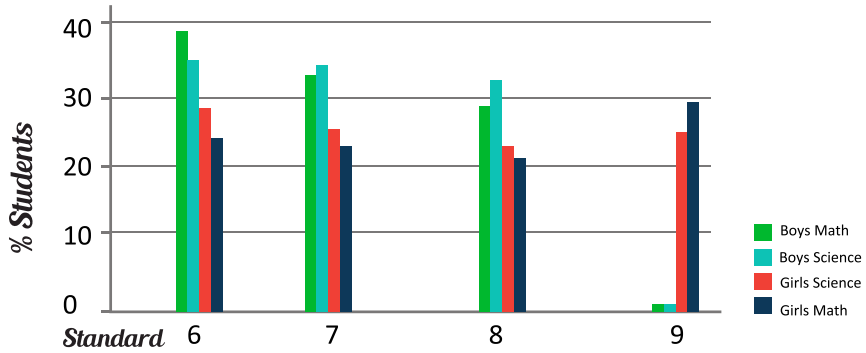
The analysis of Science and Maths results was undertaken in 9 Government Girls' Schools, 6 Government Boys' Schools and 1 Government Co-Educational School. The sample focused on students from 6th- 9th Classes. These government schools were specifically selected as these were the ones attended by the girls in the FAT Tech Center.

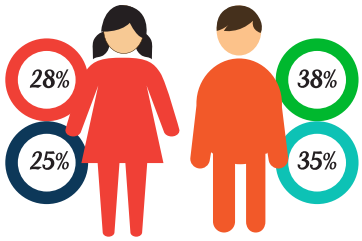
Looking at the annual exam performances of girls and boys as reflected in the figure below, one finds that from lower to higher classes, performances of the boys in Maths and Science deteriorated considerably compared to girls. The sharp decline in the 9th standard can also be attributed to increase in difficulty level in both Science and Maths. Since they struggled with their basics, advanced classes were difficult to handle. This also emerged as one of the key responses from the FGDs. Yet many of these girls continued to hold the belief that STEM courses were not for them to pursue.

Comparison between Girls & Boys in Maths & Science Performance i 6th-9th Classes

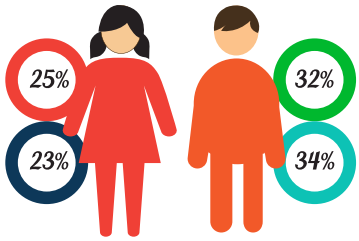








Standard 6th



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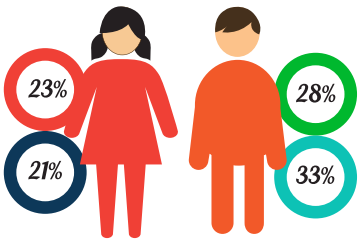
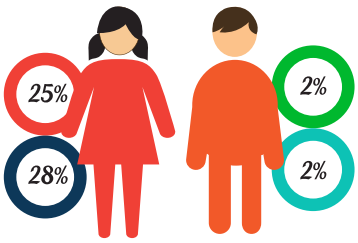


Standard 8th



Standard 9th

The percentage presented here refers to number of girls and boys who scored above class average in the mentioned subjects.

In further analysis of performance in Maths and Science separately, it emerged that there is no stark difference between boys and girls though there was slightly better performance of girls in comparison to boys. In Science, girls showed more fluctuation in their performances than Maths.

This information was critical as this highlighted that girls were doing better than boys in the STEM subjects, forcing one to wonder about the reasons for the same girls not choosing STEM in higher classes, whereas boys did explore that option. This analysis of results is important as it informed the researchers about the exact reality where the performances of girls and boys in the government schools are concerned.

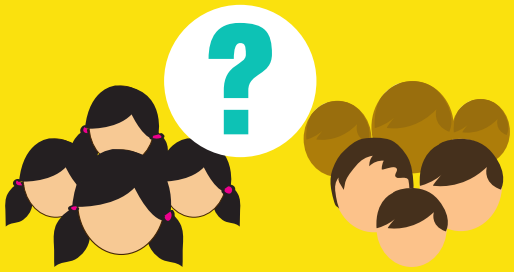
FOCUSED GROUP DISCUSSION TO UNDERSTAND GENDERED NATURE OF STEM

Following the results analysis, Focus Group Discussions (FGDs) were held in 5 government schools and 1 private school.

These covered 10 students from each class (6th -10th), totaling to as many as 300 students. From the FGDs, the given responses were later categorized across three themes:

1. Personal factors 2. Social/Familial factors, 3. Institution related factors.

There were a total of thirty FGDs that were conducted. Each class FGD lasted for an hour with the questions focused around the factors that kept them interested in the STEM courses or what made it challenging for them.



Questions focused around the factors that kept them interested in the STEM courses or what made it challenging for them.

The predominant responses were about their level of understanding and interest in STEM. There was also a genuine belief among both girls and boys that boys were actually better than girls in STEM. To support this statement, many of the students quoted as evidence the relatively few women scientists and inventors across time, as compared to the number of male scientists. Some of the students acknowledged that girls have a higher share of household responsibilities than boys, and that this allowed less time to engage with STEM subjects. These were the very subjects that required more practical application. A few of the students felt that there were financial implications in choice of subjects.

Table reflects some prominent responses from the participants that were later incorporated within the questionnaire to be taken to a larger sample. A marked number of participants stated that infrastructural and institutional factors influence how students engage with STEM courses. Both girls and boys attributed this as a reason, but girls also brought up the attitude of the teachers and their skills (or lack thereof) in making STEM interesting and achievable to them. (Annexure # 1 FGD questions for further reference).

LIST OF THE PREDOMINANT FOCUS
Group Discussion Responses

The group discussion response is done at three levels- Indivisual, Social/Family, Institutional

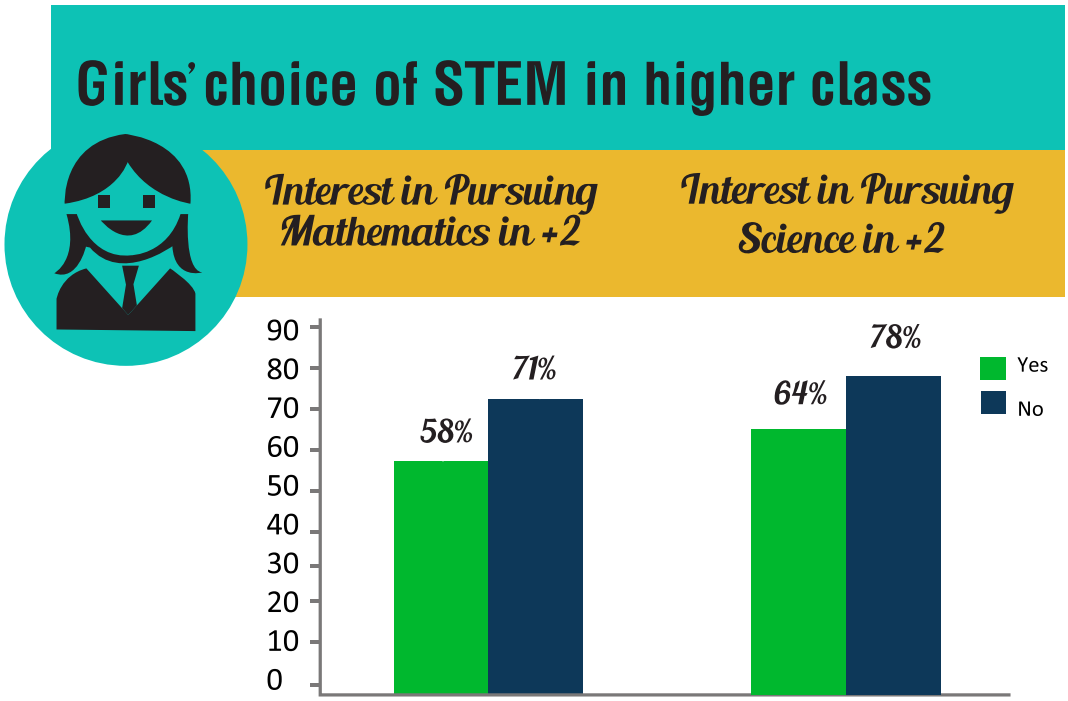
Individual					
Students find Maths & Science very difficult/don't like it	Language Barrier in understanding STEM subjects	STEM has lesser employment opportunities than humanities	There is no interest in pursuing STEM courses	Perception-Boys are good in STEM subjects	Boys create more technology
24%	11%	12%	12%	7%	11%

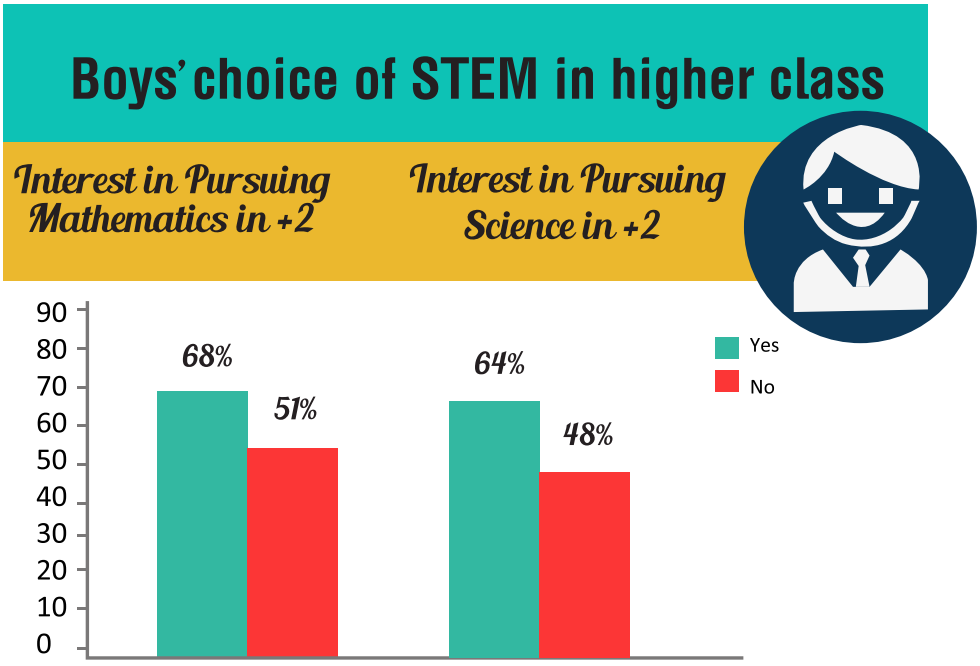
Social/Family	
Girls are mostly involved in household chores	Girls are better behaved and sincere whereas Boys are easily distracted
26%	14%

Institutional			
There are no functional labs in the schools	Tuitions are needed to do well in STEM courses/ Teachers encourage students to take tuition	Most government Schools don't offer the STEM courses	STEM courses are offered in English and this becomes a struggle as Hindi is a primary language in earlier classes
60%	54%	12%	12%

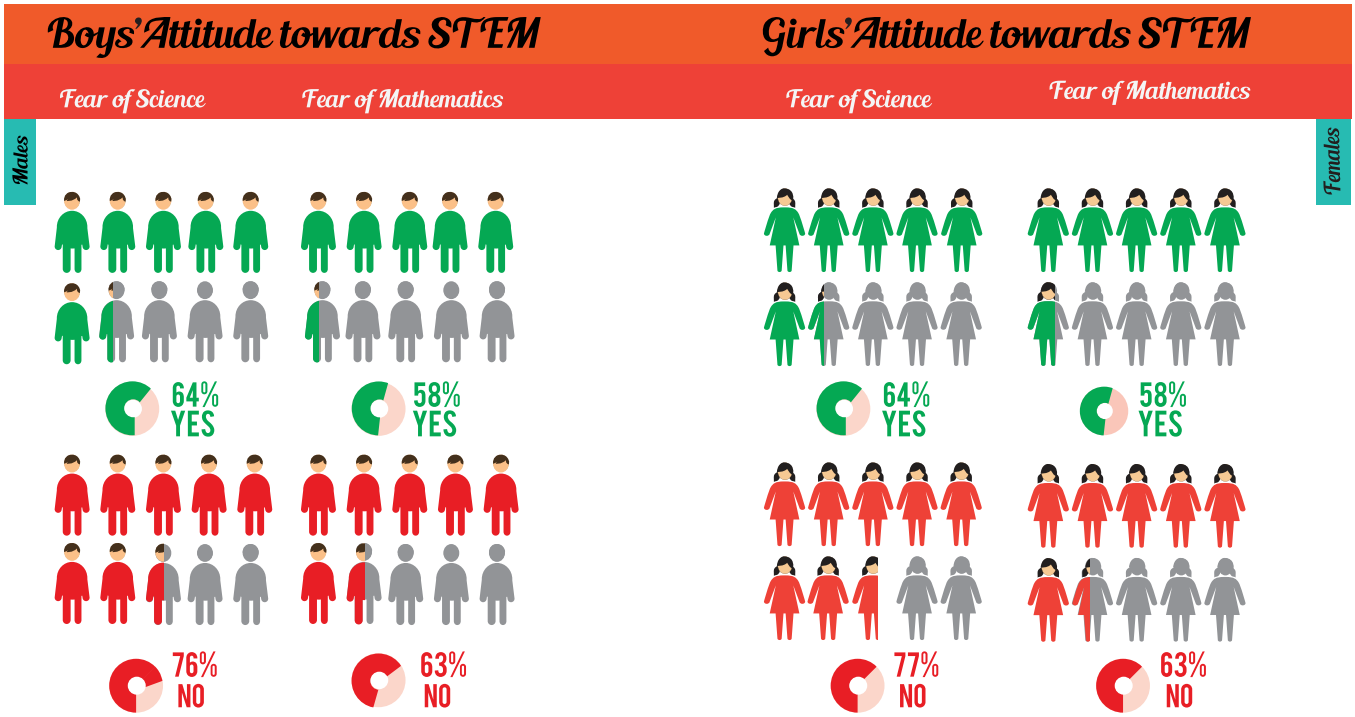
QUESTIONNAIRE IN SCHOOLS

The final step in this study was taking a questionnaire to students of the same schools where the FGDs were conducted. (The questionnaire is included as Annexure # 2.) This questionnaire was made on the basis of the responses from FGDs and some of the questions were adapted from the Google RISE questionnaire which has been used globally for similar assessment of gender differences in STEM courses. There were a total of 19 questions covering the themes: individual, institutional, infrastructural and familial factors. These were filled by a total of 2615 students across 5 Government schools (3 Government Girls' Schools, 2 Co-educational Government Schools) and 1 Private Co-educational School. (The profiles of the schools are attached as Annexure # 3). The questionnaire was a combination of open-ended and close-ended questions. The questionnaire captured a larger number of views in order to explore the research question. In the sample, there was a distinctly high number of girls in comparison to boys. This was deliberately chosen as the study wanted to focus on the girls and their understanding and interpretation of the situation. It was also meant to be a space for their voices to be recognized. This recognition helped the study unfold many reasons for inhibiting girls in pursuing STEM subjects. One of the significant results that emerged from this study was that boys are committing to explore STEM courses irrespective of their performance. This is reflected in figure. If one were to dig deeper, one would find that there is an amalgamation of reasons and therefore one cannot just focus on one or two reasons.

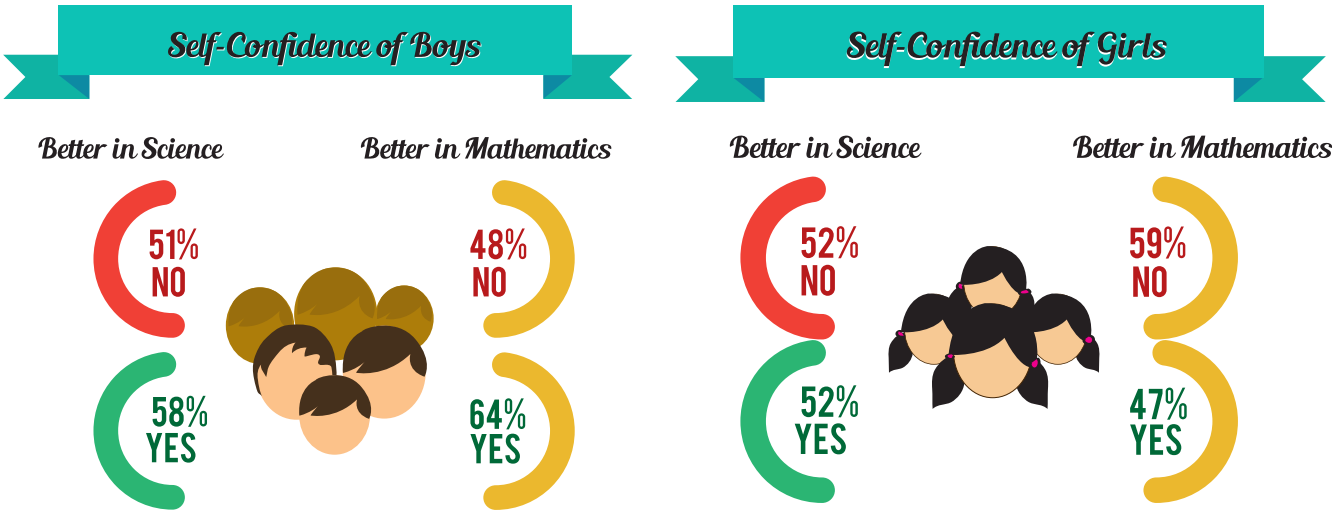




There may be individual experiences that mould the way young girls look at themselves and their academic abilities in such courses. Within the Indian context, there still exists a difference in the manner in which boys and girls are brought up and socialized. From the data of this study, as seen in Figures, it emerged that both girls and boys were not fearful of STEM and this is statistically significant. Therefore, not choosing STEM may not be attributable to such a fear.



This is in contradiction to the common belief that STEM is not chosen because it creates a psychological fear among students.The reasons why dissuasion for STEM courses happen may be classified in terms of individual attitudes, parental and/ or familial factors, and prevalent social factors which cover institutions and cultural beliefs (Refer to the table given on page 12). It is commonly believed that boys have higher academic achievement in STEM than girls (contrary to the results that were analyzed in the study). Often, this may be the underlying mes-sage that the girls receive from different people in their lives making them accept it as the reality. Some literature suggests that the gender gap is less of an ability gap and more of a gap in perceptions of STEM subjects.

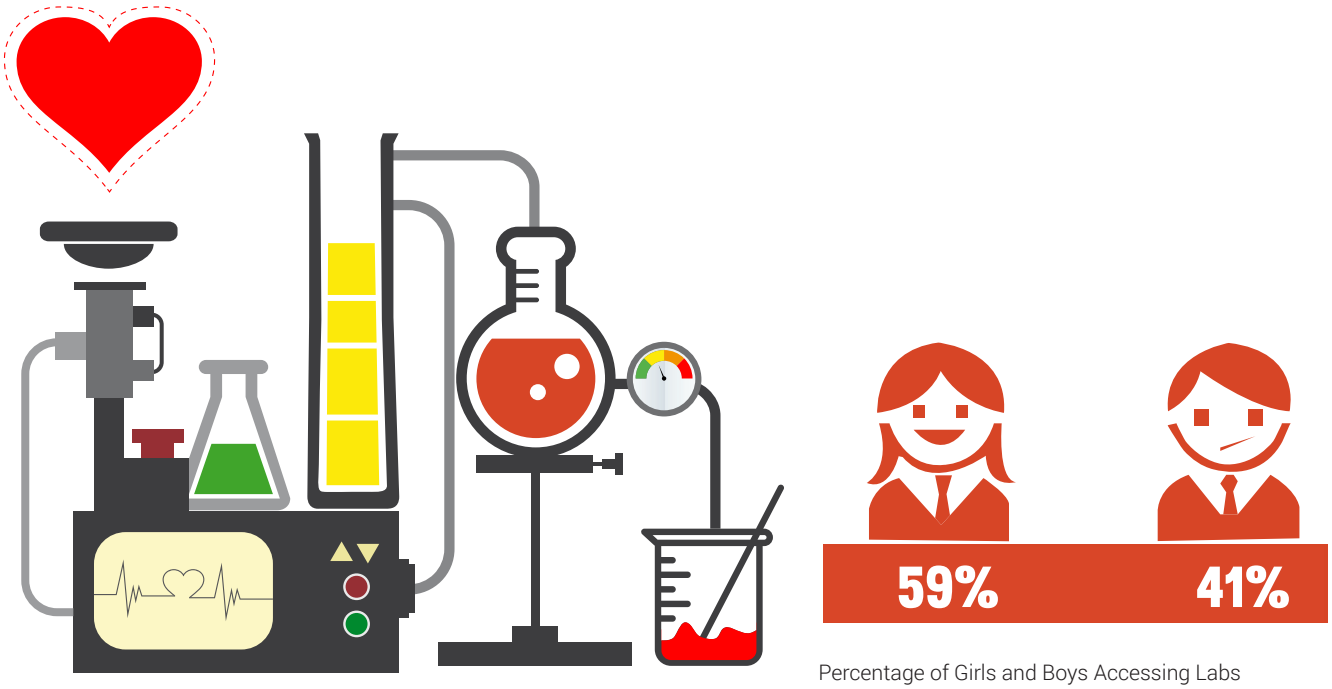


In 1994, Sadker & Sadker found that the gendered difference in perceived STEM capabilities is indicative of a term coined as "confidence gap" (as reported in Bray, 2007). This was reflected even in the data that was collected in our study and is shown in the Figures that the reasons for disengagement may be other external factors. It did emerge though that a strong sense of self-efficacy is much needed among girls, because in spite of not being fearful girls, self-reported that they were not better in STEM in comparison to boys.

The girls perceived STEM fields and subjects to be more demanding than social sciences because of the preconceived notions about the levels of difficulty, commitment and time requirement of the former over latter. In the focused group discussions, some girls did talk about their challenges with regards to these subjects. Collating the responses from FGDs and the questionnaire we perceived a common thread of reasons why girls are hesitant to pursue STEM subjects.

In the sample of the schools that are part of the study, it was noted that none of the government schools had adequate infrastructural support in terms of the laboratories as well as technology. Both girls and boys responded that they did not have access to laboratory facilities when the need arose. Data presented below indicates that there is no significant difference between the girls and boys in their responses. It was shared that there were some laboratory facilities in schools, where teachers facilitated basic scientific experiments, yet these were infrequent and often non-functional. This is comparable to the private school that was included in the sample where infrastructural support to the teachers and students allowed deeper and innovative engagement with the subject by the young students. Though the differences did not emerge statistically significant in this, but in the FGDs, the most cited reasons by girls for not looking at STEM favorably was the lack of infrastructural support, innovative methodologies and pedagogy- in addition to their individual as well familial reasons. In private schools, the same were the sources of facilitating interest among the students be it girls or boys. Use of technology has been the predominant learning methodology in private school along with experiments.

There may be individual experiences that mould the way young girls look at themselves and their academic abilities in such courses. Within the Indian context, there still exists a difference in the manner in which boys and girls are brought up and socialized. From the data of this study, as reflected in the figure below it emerged that both girls and boys were not fearful of STEM and this is statistically significant. Therefore, not choosing STEM may not be attributable to such a fear.



Percentage of Girls and Boys Accessing Labs

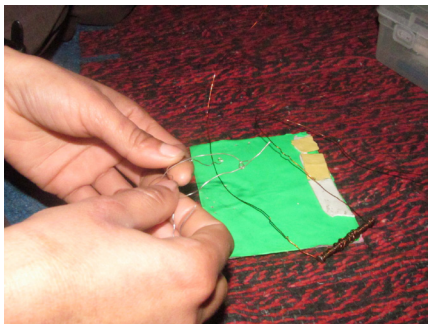
STEM BIASES: EXTERNAL FACTOR

One must stress that in this study, we did not go deeper onto what the parents' responses were, but rather focused on girls and boys and looked into how they see factors influencing their choices for STEM.

Young girls, especially from socially and economically disadvantaged families, contribute a great deal to the household work, take care of their younger siblings and help their mothers. Thus, there are both economic as well as social conditions that strongly impact the way parents look at the girls in their families. A range of responses were elicited from young people as to how their parents view them and their academic engagements. They see that girls once married are better suited for jobs such as teaching which will be less time consuming and (presumably) require less effort. In such scenarios, with families mostly economically marginalized, the financial support is more for boys who are assumed to grow up and take on professions which will allow them to take care of their families, whereas girls are at best seen emerging as sources of secondary income support.

Also, the low teacher-student ratio is a reality within the government school system. Though girls' enrollment in math and science courses has increased since the past decade, sexist behavior on part of both teachers and students is higher in such courses than it is in other courses as has been shared by the girls during the FGD. Since teachers are an important aspect of building interest in STEM, there might be a need to explore whether this is an assumption on part of the girls. But it does emphasize that engaging teachers and equipping them may benefit girls in the long run. It has been found that instructional practices were positively, but weakly related to mathematics achievement for both age groups and domains of mathematics achievement (Anderson et al., 2006). There are multiple levels involved and as a result, if one is suggesting an intervention, then it needs to be planned systemically covering different stakeholders at various levels. The mandate for FAT is clear and focused on girls from marginalized groups and recommendations emerging from the study are towards creating interventions that facilitate this process.

The question for us to examine is then whether one takes this as status quo and lets it remain unchallenged or looks for alternatives to encourage the young girls so that their attitudes towards STEM courses changes towards a positive aspiration for it as a career. It is on this premise that some of the recommendations are being made for designing interventions with different stakeholders that can be taken as learning from this study.



CONCLUSIONS & RECOMMENDATIONS

The results threw up some interesting observations for the researchers with respect to the level of understanding of STEM among girls from economically marginalized backgrounds. One observation was that quite a number of participants struggled with language. They were unable to understand and assimilate what was being shared with them even though the local language was used for communication and the questionnaire was also translated into it. Some also struggled with the content of the questionnaire as well as in FGDs that were related to STEM, and this became evident in their engagement with the researcher on the topics concerned with the subject. This highlights that if they struggle with early foundational classes, then with time there will be a greater struggle with the scientific and technical content of STEM subjects in higher classes.

1. *One needs to plan and design interventions for generating interest in STEM among girls of such background by using creative and simple methods.*

2. *In order to build their abilities and interest, this intervention can be two-fold—one being exposure to role models and second being laying early foundation of interest in the field.*

3. *Interventions need to be targeted at girls as well as teachers to build their interest and abilities as well as sustain it. Bringing in different stakeholders such as teachers will ensure that student – teacher engagement is long-term and not just one-off.*

When one deconstructs the multiple meanings of gender and science, then it is critical to realize that it is not necessary that STEM is always taken up as a career choice, but what will benefit these girls is even encouraging and developing an interest in STEM as an everyday phenomenon. This will challenge the notion that it is something that is well understood only by boys. This would require envisioning ways of bringing science close to everyday experience and bursting the myth that girls are not capable of taking up STEM. Learning science is an embodied activity that demands not just learning content, but also participating in scientific or science related communities and processes.

CONCLUSIONS & RECOMMENDATIONS

Looking at 'intent' then one is keen to explore whether there is confidence among girls that they can do well in college, to be able to come out of college to get into a related career and be successful in it. A critical base to all this is whether there is a 'perception' of opportunities available with respect to careers in STEM which is challenging, and economically viable. So our suggestion is to start small by exposing young girls to various role models within the system so that the interactions with role models and hearing their stories makes STEM a feasible option for them.

FOLLOW UP WORKSHOPS IN THE SCHOOLS

As part of the study, research was followed by incorporating the recommendations into workshops aimed at the students of some of the schools that were part of the study.

Two-day workshops in three schools and a three-day workshop in the Tech Center with the girls were conducted. The themes within the workshop was around interaction with women in the STEM field- such as computer engineer, research scientist, doctor, Maths teacher (who was also editor of books on STEM)- that allowed girls to have a dialogue with these women about their experiences. They also provided inputs in areas of Magnetism, Electricity and Computers along with practical experiments where all participants were involved. There were also screenings of short films focused on the life of Kalpana Chawla[1] , women of Tilonia[2] and rocket launching process in NASA. A short film, Apna Haq made by the girls from the Tech Center was also screened and an interaction with some of the girls involved in its making was organized during these workshops. The workshops were aimed at expanding the girls' horizons with respect to STEM so that they could bring their fears and inquisitiveness into the open and develop an interest in the field.

> "The response from the participants of the workshop was overwhelming; they found it interactive and engaging. One participant shared she "had always thought of women not competent enough to be in professions such as medicine, doctor and engineering."

Name of the School	Students attending Workshop	Faculty attending Workshop	No. of Students attending Screening
Govt. Co Ed Sr. Secondary Lajpat Nagar 1	30 girls	5 teachers + Principal [Science and Maths teachers]	50
Govt. Co ed. Nehru Nagar	30 girls	5 teachers + Principal [Science and Maths teachers]	50
GGSSS Srinivaspuri	30 girls [45 girls sat and observed]	5 teachers + Principal & Vice-Principal	75

In addition, the teachers' response also hinted that such workshops generated interest in the field and their interactive nature provided a scope for asking questions beyond the textbooks' content.

Therefore, it has been observed that if an exploratory space, with support and right infrastructure is provided, girls can enhance their knowledge and take up STEM- related jobs, that are going to be multiplying in coming times. This will also erase internal fears and external stereotypes against women and STEM. There is nothing inherent about STEM being gendered but it's the inherent gender roles and oppression that has discouraged and removed girls from this field.

1. She was the first Indian American astronaut and first Indian woman in space. She first flew on Space Shuttle Columbia in 1997 as a mission specialist and primary robotic arm operator. In 2003, Chawla was one of the seven crew members killed in the Space Shuttle Columbia disaster.

2.Tilonia, a small village in Rajasthan, India is the home of the Barefoot College. Since 1972, the College has worked to improve the lives of the rural poor by addressing basic needs for water, electricity, housing, health, education and income. Today, women from more than 50 countries in Africa, Asia and Latin America have been trained by the College to solar electrify their own communities.

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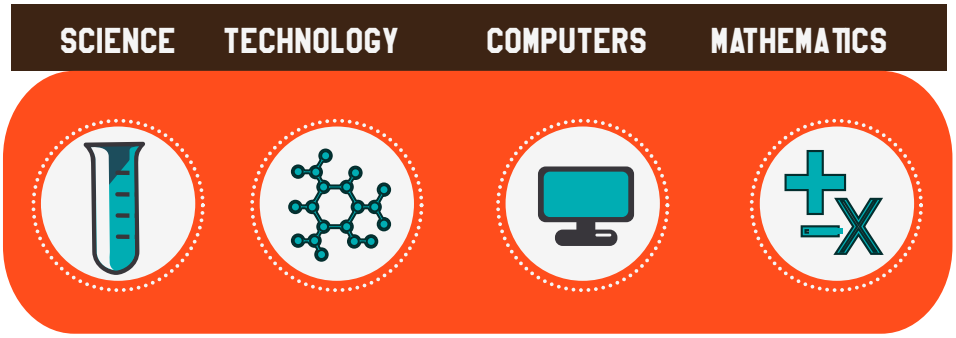
ANNEXURE 1

Focus Group Discussion questions for 6th-10th grade (Science and Math & Computers*)

RAPPORT BUILDING

Introduction and building of rapport (5-10 min)

* What is the first thing that comes to your mind/ what do you associate the following words/subjects with:



* Ask about their favourite subjects?
What do you like about their favorite subjects?

1 What do I believe in :A Buzzer round

a) Who does better in Science?
Depending on answer: Why do you think so? Probe
If neither/either? Then why.
Do other people think so?
Why?
Expected responses
I.Girls/boys work harder
II.Girls/boys are more intelligent
III.Girls/boys are more imaginative and innovative

b) Who does better in maths?
Depending on answer: Why do you think so? Probe
(same as for science)
Expected responses:
I.Girls/boys are more hard working
II.Girls/boys are more intelligent
III.Girls/boys have better concentration

c) Science is a very difficult subject
If yes, then why do you think that is? Probe
Expected responses:
I.Science requires a lot of hard work
II.Only very intelligent students can study science
III.I don't find it interesting
IV.I don't understand it

d) Maths is a very difficult subject.
If yes then why do you think that is? Probe
Expected responses:
I.I don't understand it
II.Only very intelligent students can study Maths
III.I don't find it interesting
IV.Maths requires a lot of practice

e) What are the other subjects that you find easy?
f) Why are they easier than maths and science?
g) To study Science & Maths in senior secondary is it necessary to take tuitions? : probe

* **3 Reasons for not opting for STEM**

Does your school offer science stream in classes 11th & 12th.

If science is not offered: Ask them have they ever thought about why it is not offered and if it's something to think about. Should they ask about / have they ever thought about asking as to why only few students in a school or few schools get that opportunity to study science.

1. If school does not offer to take science stream would you like to change schools and move to a school that offers Science stream
2. Would you be able to
3. What are the possible hindrances that you anticipate?
4. Would you fight for it?

If the school offers then:

1. Are you aware of the criteria for giving science stream to students?
2. Would you like to opt for Science stream in senior secondary.
3. Would you be able to opt for it? Why not? And If not then what would you do then?
4. Would you settle for another stream or look for opportunities elsewhere?

* Would you like to opt for Maths in Senior Secondary
  If not, then why?
* Would parents have a say in your stream choice? If yes then to what extent.
* Would you debate and discuss if you disagree with them, will you put their point forth?

* **4 School Infrastructure:**

a) Science classes in our school are interactive and enjoyable.
Teachers methodologies, attendance, time devoted to individual students.
Probe; elaborate
Why/ how. Why not?

b) Maths classes in our school are interactive and enjoyable.
I know ways in which Science & Maths & Computers is utilised in our everyday life. If yes, list a few examples.
Ask them to explain. Do they understand where all science and computers are used in our daily life.
Would you like to know more?
How would you like classes to be, to learn more, understand better?

5 Future Related to STEM

* Do you think science stream gives limited job options after school.

Is yes: Why do you think that is? probe about perceptions of the value of science
If not, then what all are the career options according to you?
Would you be interested in pursuing any of them?
If yes, then would you be able to? If not, then what are the hindrances?

* I am likely to study a STEM related field in college. (Maths/Sciences/Computer Science/ Engineering/Medicine)

College is an option? Practicality?
What would you like to study? Why?
What afterwards/ career options?
What and why? When did you decide that?

6 CONCLUDING QUESTIONS

* What will help you choose the Science & Maths Stream as an option? What kind of support you seek and from whom?

* What barriers exist/ may come in your way in your pursuit of science and maths?
English language, self esteem, domestic chores-lack of time, tuition required-expensive.

* What other problems do you face at school?

ANNEXURE 2

Questionnaires for 6th-10th grade (Science and Math & Computers*
*Computers related questions to be answered only when applicable.
All questions are compulsory.

Name:
Age:
Class:
School:

Grade received in last two Annual Exams
2012 2013
Science:
Maths:

Tick ( ) in front of the appropriate response:

1. a)Do you take tuition for Maths?
Yes No
Computers*:

b) Do you take tuition for Science?
Yes ☐ No ☐

2. Rank following subjects in the order of your preference (1 being the highest and 5 the lowest)
Science: ____.
Social Studies: ____.
Maths: ____.
English: ____.

3. a) My school offers science stream in classes 11th & 12th.
Yes ☐ No ☐

b) If Yes, I would like to opt for Science stream in 11th & 12th.
Yes ☐ No ☐

c) If No, I would like to change schools and move to a school that offers Science stream.
Yes ☐ No ☐

4. I would like to opt for Maths in 11th and 12th.
Yes ☐ No ☐

5. I would like to opt for Maths in 11th and 12th.
Yes ☐ No ☐

6. My parents will decide what stream/subject I choose in class 11th and 12th.
Yes ☐ No ☐

7. I think science stream gives you limited job options after school.
Yes ☐ No ☐

8. I have conversations around Science, Maths & Computers with parents, siblings & friends.
Yes ☐ No ☐

9. What do I believe in:

a) Science is a very difficult subject.

Yes ☐ No ☐

If yes, then why do you think that is?

•Science requires a lot of hard work
•Only very intelligent students can study science
•I don't find it interesting
•I don't understand it

b) Maths is a very difficult subject.

Yes ☐ No ☐

If yes then why do you think that is?

5.I don't understand it
6.Only very intelligent students can study Maths
7.I don't find it interesting
8.Maths requires a lot of practice

c) Computer Science is a very difficult subject*

Yes ☐ No ☐

If yes then Why?

2.I don't understand Computers
3.It is very boring
4.Any other reason_____.

d) To study Science & Maths in senior secondary it is necessary to take tuitions.

Yes ☐ No ☐

e) Who does better in Science?

Girls ☐ Boys ☐

If girls, then choose the reasons given below.

I. Girls work harder
II. Girls are more intelligent
III. Girls are more imaginative
IV. Any other reason

_____

If boys, then choose the reasons given below.

I. Boys work harder
II. Boys are more intelligent
III. Boys are more imaginative
IV. Any other reason

_____

f) Who does better in Maths?

Girls

If girls, then choose the reasons given below.

I. Girls work harder
II. Girls are more intelligent
III. Girls are more imaginative
IV. Any other reason

_____

Boys

If boys, then choose the reasons given below

I. Boys work harder
II. Boys are more intelligent
III. Boys are more imaginative
IV. Any other reason

_____

10. a) Science classes in our school are interactive and enjoyable.

Yes ☐ No ☐

b) Maths classes in our school are interactive and enjoyable.

Yes ☐ No ☐

c) Computer classes in our school are interactive and enjoyable.*

Yes ☐ No ☐

11. We have functional science laboratories in our school.
Yes ☐ No ☐

12. Classes are held in science labs on a regular basis.
Yes ☐ No ☐

13. We have functional Computer laboratories in our school. *
Yes ☐ No ☐

14. Classes are held in the Computer labs on a regular basis.*
Yes ☐ **No** ☐

15. I know ways in which Science & Maths & Computers is utilized in our everyday life.
Yes ☐ No ☐

16. I am likely to study a STEM related field in college. (Maths/Sciences/Computer Science/ Engineering/Medicine)
Yes ☐ No ☐

17. I think that I could be successful in a job in Science & / Maths/ Computers related field
Yes ☐ No ☐

18. If Yes, then tick (✓)in front of any three appropriate responses:
___ I believe that I am smart.
___ I believe that I can achieve any goal I set.
___ I have met people that have chosen science as their field.
___ I have a good understanding of the field.
___ My school gives me the chance to learn about science/maths/computers.
___ I think Science & / Maths/ Computers related field is interesting.
If No, then (✓) in front of any three appropriate responses:
___ I think Science & / Maths/ Computers related field is too hard.
___ I don't think there are a lot of jobs in the field of Science & / Maths/ Computers related field that I would like.
___ I don't understand Science/ Maths/ Computers.
___ I think Science & / Maths/ Computers are boring.
___ My school does not give me a chance to learn about sciences.
___ Science is for studious children.
___ I think people who work in the field of science do a lot of work by themselves and I don't want to do that.

19 a. I want to take up Science/Maths in 11th class?
Yes ☐ No ☐

b. I want to take up Science/Maths in class 11th, because (Choose the appropriate option)
_____Will need more marks.
_____ I am interested in it.
_____of my family members.
_____Haven't decided about future.
_____Have to work at home, don't get time to read.
_____ it's taught in English, therefore very difficult to understand.
Any other reason_____

ANNEXURE 3

PROFILE OF SCHOOLS

Sarvodaya Kanya Vidyalaya

This school is located in East of Kailash. It was established in the year 1975. Though it has co-educational status more girls are present in the school than boys. It has 27 teachers and 8 non-teaching staff. The school has 14 classrooms, a library and a hall.

Govt. Co Ed Nehru Nagar

This school is located in Nehru Nagar. It was established in the year 1970. It assumed its co-educational status in 1996. It has 38 teachers including Principal and Vice Principal. The students come from the slum areas and Jhuggi clusters of Nehru Nagar. The school has a semi-pucca structure and the infrastructural facilities include two science labs and 1 Physical Science Lab, computer lab, home science lab and a hall.

Govt. Co Ed Lajpat Nagar 1

This school is located in Lajpat Nagar 1. It was established in the year 1952. It's a co-educational school. The school has a pucca structure and infrastructural facilities include a hall and a computer lab. The school offers both science and arts streams. The school doesn't offer any vocational programs.

Govt. Girls Senior Secondary School

This school is located in Srinivaspuri. It was established in the year 1965. It has always been an all girls institution. It has 41 teachers including Principal and Vice Principal, and a total of 1361 students.

Government Girls Senior Secondary School

This school is located in East of Kailash. It was established in the year 1975. The co-educational status of the school is girls only. It is managed by Department of Education. It has 27 teachers and 8 non-teaching staff. The school has 14 classrooms, a library and a hall.

BlueBells School International

This private school is located in Lajpat Nagar IV. It was established in the year 1957. The school is affiliated to Central Board of Secondary Education. It has a faculty of 150 teachers. The school has 90 classrooms, 4 multipurpose halls, an AV room, and an auditorium. The school offers both Science and Arts streams.

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