IMPACT OF INTERVENTION PROGRAM ON THE ATTITUDE OF SECONDARY GIRLS' STUDENTS TOWARDS STEM EDUCATION

SUMMARY

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SUMMARY

Introduction

This chapter provides a comprehensive summary of the present study, detailing its execution and findings. It covers various aspects, including the study's background, need, significance, and scope. Additionally, it outlines the objectives and hypotheses, describes the methodology employed, and discusses the tools used for data collection. Major findings of the study are presented, along with the developed module. The chapter concludes with educational implications and suggestions for future research. In essence, this chapter offers a concise overview of the entire study.

Rationale of the Study

Through a comprehensive review of the literature, it has been well-established that women and girls are significantly underrepresented in STEM subjects. In India, Data from the National Science and Technology Management Information System (NSTMIS) of the Department of Science and Technology, the National Sample Survey (NSS) of the Ministry of Statistics and Programme Implementation, NITI Aayog, and the All India Survey on Higher Education (AISHE) by the University Grants Commission (UGC) all reveal a significant gender disparity in the field of STEM. These comprehensive datasets highlight the underrepresentation of women in Science, technology, engineering, and mathematics at various educational and professional levels. Despite ongoing efforts to promote gender equality, the statistics discussed above reflect that women continue to face substantial barriers to entry and advancement in STEM disciplines. These barriers are multifaceted, including societal norms, educational biases, and workplace discrimination, which collectively hinder the progress and participation of women in STEM. Many studies indicate that gender stereotypes and the lack of visible role models are primary factors contributing to women's limited participation in these fields. Gender stereotypes regarding STEM ability have significant implications for engagement and motivation in pursuing a career in STEM later in life. In their study, Mascret & Cury (2015) found that evidence suggests that science ability can be viewed as gender innate. According to Cundiff et al. (2013) and Schuster & Martiny (2017), these stereotypes harm women's self-efficacy in STEM subjects and their motivation for pursuing STEM careers. Deeply ingrained from childhood, these biases perpetuate the belief that males

possess an inherent aptitude for technical disciplines. According to Mulvey & Irvin (2018), Despite consistently outperforming boys in STEM subjects, these stereotypes erode girls' self-efficacy and confidence in their ability to excel in STEM areas. Merayo and Ayuso (2022) found in their study that girls appeared less confident in their ability to excel in STEM careers than boys, who exhibited greater confidence in their skills.

Studies reveal that girls are not interested in choosing STEM subjects and making their careers in STEM fields. The results from a pre-study survey conducted by the researcher reveal that 64% of girls have negative attitudes towards STEM subjects. This negativity is attributed to factors such as parental and teacher motivation, societal perceptions, and social conditioning, all of which influence girls' attitudes towards STEM subjects. According to Master et al. (2014), the role of female teachers of STEM subjects and role models will significantly enhance the attitude of girls' children in STEM subjects. Cheryan, Siy, Vichayapai, Drury, & Kim (2011) found that Female role models and science fiction movies like Star Wars that challenge STEM stereotypes can change women's beliefs about their potential in STEM fields. Given the potential for even small interventions to significantly impact girls, it is essential to explore strategies for fostering positive attitudes towards STEM education. Studies by Van den Hurk, Meelissen, and van Langen (2019) suggest that interventions that enhance knowledge, skills, motivation, teaching approaches, and a sense of belonging can effectively increase interest and persistence in STEM education.

Reviewing related literature, the researcher found that few studies have been conducted on enhancing girls' attitudes towards STEM education. Moreover, there is a noticeable gap in research explicitly focused on the enrollment and retention of female students in STEM subjects in India. Hardly any studies have been dedicated to developing intervention programs aimed at improving or increasing girls' attitudes and participation in STEM education. This lack of focused research underscores a critical need for more comprehensive studies and innovative programs that address the unique challenges faced by girls in STEM. In light of this understanding, this research study aims to develop an intervention program aimed at positively influencing the attitudes of secondary school female students towards STEM Education.

Statement of the Problem

IMPACT OF INTERVENTION PROGRAM ON THE ATTITUDE OF SECONDARY GIRLS' STUDENTS TOWARDS STEM EDUCATION

Operational Definitions of Key Terms

- **Intervention Program:** In this study, the Intervention program refers to the workshop of 90 days, including activities to influence the attitude of Secondary Girl students towards STEM Education.
- **Attitude:** It refers to the Cognitive, Affective, and Behavioural domains of attitude of secondary girls' students towards STEM Education. This attitude scale includes the three domains of attitude, i.e., cognitive, affective, and behavioral.
- **Secondary Girl Students:** In this study, Secondary Girl Students are those students who are studying in standard IX in secondary schools in Lucknow city, Uttar Pradesh, India.
- **STEM Education:** It refers to the acronyms of Science, Technology, Engineering, and Mathematics Education.

Research Questions of the Study

The research questions of this study are

- What is the present status of girls in the area of STEM in India?
- What is the attitude of secondary girl students towards STEM Education?
- What is the attitude of parents towards their girl child to select STEM subject?
- What are the obstacles and problems that girls face in selecting these subjects?
- What strategies or ideas are available to motivate girls towards STEM Education?
- How impactful is the Intervention Program in influencing the girls' attitude towards STEM Education?

Objectives of the Study

1. To study the present status of girls in STEM Education in India.
2. To identify the factors those hinder Secondary girl students from opting STEM subjects.
3. To develop the Intervention Program for influencing the attitude of Secondary girl students towards STEM Education.

4. To implement the developed Intervention Program on Secondary girl students.
5. To analyze the impact of the Intervention Program on the Attitude of Secondary girl students towards STEM Education.

    5.1 To compare the mean scores of the attitude scale of the Pre-test of the experimental group and control group.

    5.2 To compare the mean scores of the attitude scale of the Post-test of the experimental group and control group.

    5.3 To compare the mean scores of the attitude scale of the Pre-test and the Post-test of the experimental group.

    5.4 To compare the mean scores of the attitude scale of the Pre-test and the Post-test of the control group.

Research Hypothesis

1. There is a significant difference between the mean scores of the attitude scale of the Pre-test of the experimental and control group.

2. There is a significant difference between the mean scores of the attitude scale of the Post-test of the experimental and control group.

3. There is a significant difference between the mean scores of the attitude scale of the Pre-test and the Post-test of the experimental group.

4. There is a significant difference between the mean scores of the attitude scale of the Pre-test and Post-test of the control group.

Null Hypothesis

1. There is no significant difference between the mean scores of the attitude scale of the Pre-test of the experimental and control group.
2. There is no significant difference between the mean scores of the attitude scale of the Post-test of the experimental and control group.
3. There is no significant difference between the mean scores of the attitude scale of the Pre-test and the Post-test of the experimental group.

4. There is no significant difference between the mean scores of the attitude scale of the Pre-test and Post-test of the control group.

Delimitations of the Study

- The present study is confined to Lucknow, a city in Uttar Pradesh.
- The present study is confined to only 9th-class girls' students of the Secondary School of Lucknow.
- Only the factors related to school and teaching practices were considered in the present study to develop an Intervention Program.

Research Gap

After a review of related literature, the researcher found that some research gaps emerge, where further investigation is needed. There are few studies on STEM Education and Gender gap in India. Despite abundant research conducted abroad on the intersection of STEM education and gender, there is a notable scarcity of studies focusing on this relationship within the Indian context. While international literature offers valuable insights, India's unique socio-cultural, economic, and educational landscape necessitates localized research to understand the specific challenges and opportunities faced by secondary students, particularly girls, in accessing and engaging with STEM education.

There is also a scarcity of research integrating STEM Education and attitudes in India. There is also a scarcity of studies that simultaneously investigate STEM education and attitudes as variables within the Indian context, which represents a significant research gap. Understanding how exposure to STEM Education initiatives influences attitudes towards STEM subjects among secondary students in India is essential for designing targeted interventions and policies that address barriers to participation and promote positive perceptions of STEM fields.

A review of related literature also provides insight into the need for more studies on the development of intervention programs to influence attitudes towards STEM education in India. Another notable gap identified is the absence of intervention studies to enhance girls' attitudes towards STEM education in India. While interventions targeting gender disparities in STEM have been implemented and evaluated in other countries, there is a shortage of such initiatives in the Indian context. Research focusing

on developing, implementing, and evaluating interventions tailored to the unique needs and challenges girls in India face can provide valuable insights into effective strategies for promoting gender equity in STEM education.

Addressing these research gaps requires concerted efforts from researchers, policymakers, educators, and stakeholders to prioritize and support empirical investigations that contribute to a more comprehensive understanding of the factors influencing attitudes towards STEM education among secondary students in India. By filling these gaps, researchers can suggest evidence-based interventions, policies, and practices that foster a more inclusive and equitable STEM learning environment, ultimately empowering all students, regardless of gender, to pursue and succeed in STEM fields.

Considering the identified research gaps and the thorough analysis of existing studies, the present study emerges as both novel and crucial. It fills a significant void in the literature by addressing the lack of research on the intersection of STEM education, gender, and attitudes among secondary students in India. By introducing an intervention program tailored to enhance girls' attitudes towards STEM education, this study offers an innovative approach to promoting gender equity in STEM fields. The originality of this study lies in its focus on integrating STEM education and attitudes as key variables within the Indian context, a dimension primarily overlooked in previous research. Doing so will not only expand the scholarly discourse but also provide practical insights that will help formulate policy and practice in girls' education and STEM promotion initiatives. The present study's novelty, originality, importance, relevance, and potential will impact girls' education and society, making it a pioneering venture with far-reaching implications. By introducing an innovative intervention program, this study addresses existing research gaps. It offers a promising pathway towards promoting gender equity and fostering a more inclusive and equitable STEM learning environment.

Research Methodology

The present study employed a quantitative research approach. The primary aim of the study was to develop an intervention program for STEM Education targeted at secondary school girls and to assess its impact on their attitudes towards STEM Education. Consequently, the nature of this study was experimental. The researcher employed a non-equivalent control group pre-test and post-test quasi-experimental design in this study.

Non- equivalent groups	Pretest	Treatment	Posttest
Experimental groups	O_1	X	O_2
Control groups	O_3	C	O_4

Where, O_1 O_3 = Pre-test

O_2 O_4 = Post-test

"X" is the treatment given to the experimental group.

"C" is the placebo given to the control group.

Sample of the study

The sample for this study comprised 120 girls' students from 9th grade of the selected schools of Lucknow city. For this study, the researcher chose schools through purposive sampling. All girl students from the two intact 9th-grade sections of both schools were included in the study. A pre-test was administered to the two intact 9th-grade sections. After that, the odd-even number method was used to divide the students into two groups. The assignment of experimental and control groups was done using the chit method.

Tool of the Study

In this study, data were collected using the following self-constructed research tools.

- Interview Schedule for Secondary School Girls
- Interview Schedule for Parents
- Attitude Scale
- Intervention Program

Procedure of the Experiment

The present study employed two groups: the experimental group, which received the experimental treatment, and the control group, which received a placebo. This design facilitated the comparison necessary for the experimental investigation.

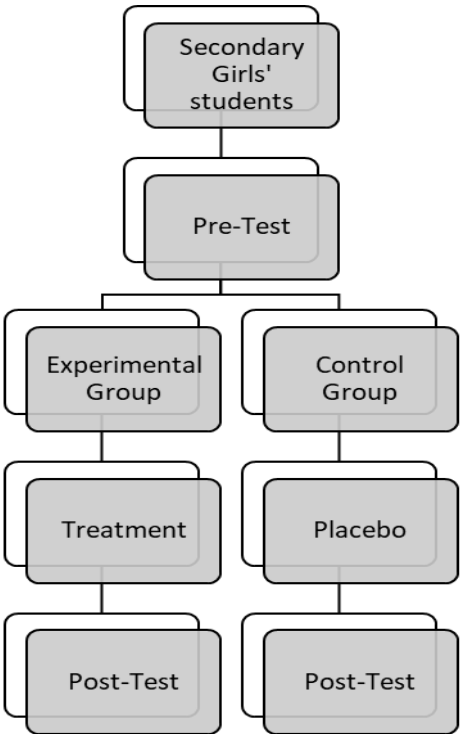

Figure 3.2 Demonstrating the outline of the Experiment

Initially, a pretest was administered to all participants. Subsequently, the participants were divided into experimental and control groups. The experimental group received the Intervention Program, while the control group received a placebo. The duration of the Experiment was 90 days.

Data Collection Process

In this study, the data was collected by administering the pre-test. The pre-test was administered by the researcher to the students. After this, the students were divided into two groups using the odd-even method, and then the two groups were randomly assigned using the chit method. The Intervention Program was administered to the experimental group, and a Placebo was administered to the control group. Following the treatment period, the post-test was administered to both groups. The differences between the pre-

test and post-test scores were then analyzed using appropriate statistical techniques to determine the relative effectiveness of the intervention program.

Statistical Techniques

The researcher used mainly the mean, standard deviation, and two-tailed t-test to analyze the data.

Result of the Study

- There is a lack of Interest among girls towards Science and Mathematics subjects
- There is a low representation of girls' students in Science and Mathematics Subjects.
- There is an attraction among girls towards General courses in Higher Education
- There is more priority towards Engineering Course among STEM
- Several factors hinder secondary girls' students from opting for STEM subjects. These include limited awareness of available scholarship schemes and government policies aimed at encouraging girls' participation in STEM, misconceptions about the scope of opportunities within STEM fields, insufficient exposure to scientific concepts among both parents and students, a lack of meaningful engagement with science and mathematics educators, and the absence of well-equipped laboratory facilities in educational institutions.
- The result of the first null hypothesis of objective 5.1, It was found that There is no significant difference between the mean scores of the pre-test of the experimental and the control group of Secondary girls' students towards STEM Education. It may therefore conclude that both groups are not different.
- The result of the second null hypothesis of sub-objective 5.2, it was found that there is a significant difference between the mean scores of post-test of the experimental and post-test of the control group of Secondary girls' students towards STEM Education. It may therefore conclude that secondary girls' students in the experimental group have more positive attitude than the girls who belongs to the control group.

- The result of the third null hypothesis of sub-objective 5.3, It was found that there is a significant difference between mean scores of the pre-test and post-test of the experimental group of Secondary girls' students towards STEM Education. It may therefore conclude that due to the impact of the intervention program, the attitude of the secondary girls' students increased as compared to the time of the pre-test.
- Based on the findings presented, it is evident that the intervention program aimed at influencing the attitudes of secondary girls' students towards STEM education yields a significant impact. The results suggest that the intervention program has effectively influenced the attitude of girls' students and potentially paved the way for increased interest and engagement in STEM fields.

Findings of the Study

- There needs to be more representation of women in STEM fields. The number of women researchers in the world is 31.7%. In India, the percentage of women researchers is 18.1%, which shows the underrepresentation of women in STEM fields.
- There is a low representation of girls' students in Science and Mathematics Subjects in secondary education. In Secondary education, women and girls from rural and urban areas tend to prefer general subjects over technical and professional ones. 28.4% of female students in rural regions have opted for science, while the percentage of female students in urban areas is 34.3%
- There is an attraction among girls to general courses in higher education. In Higher education, women and girls, whether related to rural areas or urban areas, are more interested in choosing general subjects rather than technical and professional subjects.
- In STEM courses, girls are increasingly prioritizing engineering courses. Girl students, whether belonging to rural or urban areas, are also interested in choosing engineering courses, but the other courses are facing a deficiency of students.

- Women's participation in extramural Research and development projects supported by various central Science and technology agencies has been 21%.
- There are many factors, i.e., Family background, Economic Condition, Misconception of Science as a Field with Limited Opportunities, Lack of scientific temperament, Wrong Teaching Practices, Inappropriate pupil-teacher ratio, Lack of interaction with teachers, Lack of infrastructure, Lack of awareness of Policies and Scholarship schemes given by Government in STEM Education that hinder Secondary Girl Students from opting STEM subjects.
- The intervention program aimed at influencing the attitudes of secondary girls' students towards STEM education yields a significant impact. The results suggest that the intervention program has effectively influenced the attitude of girls' students and potentially paved the way for increased interest and engagement in STEM fields.
- The Virtual Lab simulation activity had a positive impact on the attitude of secondary school girls towards STEM education.
- The interactive scientific games positively influenced the attitudes of secondary school girls towards STEM education, keeping them engaged and interested.
- The role play and movie show activities positively influenced the attitude of secondary school girls towards STEM education.
- The discussions on various government schemes and policies aimed at increasing girls' interest in STEM education positively impacted the attitudes of secondary school girls towards STEM education.

Conclusions

- Despite global efforts, there still needs to be a significant underrepresentation of women in STEM fields. The underrepresentation of women in STEM requires comprehensive strategies, including educational reforms, workplace policy changes, and societal shifts in attitudes towards gender roles in science and technology.
- There is a lack of interest among girls in science and mathematics, as we can see in secondary education. Girls from rural and urban areas prefer general subjects

over technical and professional ones, and this trend continues in higher education, where women and girls predominantly choose general courses over technical and professional subjects, regardless of their rural or urban backgrounds.

- Despite the general trend, girls are interested in engineering courses within the STEM fields. However, other technical courses need more female students. To address the deficiency of female students in other technical courses, it is crucial to apply similar strategies that have been successful in engineering. This includes increasing visibility, providing mentorship and support programs, enhancing early exposure, and promoting the value and opportunities in these fields. By creating a more balanced and supportive environment across all technical disciplines, it is possible to encourage more girls to pursue a broader range of STEM careers.

- Women's participation in extramural research and development projects supported by central science and technology agencies is 21%. Addressing the underrepresentation of women's participation in these research projects requires concerted efforts from policymakers, institutions, and the scientific community to create an inclusive environment that supports and encourages women researchers.

- Several factors hinder secondary girls from opting for STEM subjects. These factors act as a barrier. Addressing these barriers requires a multifaceted approach involving policy changes, educational reforms, community engagement, and increased investment in resources and support systems. It is possible to create a more inclusive and encouraging environment for girls in STEM education by tackling these challenges.

- Intervention programs aimed at influencing the attitudes of secondary girls towards STEM education have shown a significant positive impact, suggesting that such programs can effectively increase interest and engagement in STEM fields among girls.

Educational Implication of the Study

The educational implications of this study are profound and far-reaching. By identifying barriers and challenges that hinder girls' participation in STEM education, this research provides valuable insights for educators, policymakers, and stakeholders.

The findings underscore the importance of implementing targeted interventions to promote gender equity and inclusivity in STEM fields. Teachers can leverage the strategies and approaches outlined in this study to create supportive learning environments that inspire and empower female students to pursue STEM subjects with confidence. Additionally, policymakers can use the evidence-based recommendations from this research to inform the development of policies and initiatives to address systemic barriers and promote equal opportunities for girls in STEM education. Overall, the educational implications of this study highlight the critical need for collaborative efforts to foster a more inclusive and diverse STEM ecosystem that harnesses the full potential of all learners. The educational implications of the study are given as follows:

For Students

- This study enhances the attitude and self-efficacy of female students towards STEM education.
- It inspires female students to pursue STEM subjects and build their careers in this field.
- Through intervention programs like this study, self-perception among girls can be positively transformed, leading to improved competence and skills in STEM subjects.
- Implementing STEM intervention programs similar to this study in classrooms can offer social support to girls, thereby enhancing their skills and knowledge in STEM education.
- This study could boost the interest and aspirations of secondary female students towards STEM education.

For Teachers

- Educators can leverage the intervention program's activities to inspire female students to choose STEM subjects.
- Through the implementation of this study, teachers can offer guidance and support to female students, fostering an increase in their efficacy and positive attitude towards STEM education.

- Utilizing this study's approach, teachers can create opportunities for female students to recognize and develop their self-efficacy in STEM subjects.
- Teachers can adapt the strategies employed in this study to create inclusive and supportive classroom environments that encourage active participation and engagement from female students in STEM-related activities.
- Incorporating elements of this intervention program, like the telling of Female Scientists and movie shows of the movie in which female scientists and engineers are the main protagonists in class, enables teachers to address gender biases and stereotypes in STEM education, promoting a more equitable learning experience for all students.
- By incorporating hands-on and experiential learning activities such as role play and STEM toy-based games, teachers can enhance the practical understanding and application of STEM concepts among female students.
- Through regular feedback and encouragement, teachers can empower female students to overcome challenges and persist in pursuing STEM subjects, ultimately fostering a culture of confidence and achievement within the classroom.

For Parents:

- Parents can utilize insights from this study to actively encourage and motivate their daughters to excel in STEM subjects.
- By engaging with the findings of this study, parents can recognize the equal capabilities of both genders and understand the importance and utility of STEM subjects. They can appreciate that STEM knowledge and skills are attainable for everyone through dedication and practice and that STEM education is inclusive and accessible to individuals of all genders and backgrounds.
- Parents can foster a supportive learning environment at home by providing resources, encouragement, and opportunities for their daughters to explore and engage with STEM concepts outside the classroom.

- Through conversations and positive reinforcement, parents can help their daughters develop confidence in their abilities and overcome any apprehensions or stereotypes associated with pursuing STEM education.
- Parents can actively seek out STEM-related activities and programs in their community to expose their daughters to diverse opportunities and role models in STEM fields.
- By advocating for equitable access to STEM education and resources within their schools and communities, parents can create a more inclusive and supportive environment for all students, regardless of gender.

Suggestions for Further Studies

No research can ever be deemed complete, as there is always room to delve deeper into unexplored areas. With each answer obtained, new questions emerge, highlighting the inquiry's dynamic and evolving nature. Both attitude and STEM education are expansive topics, encompassing numerous dimensions warrant further investigation. Consequently, the suggestions for future study include:

- The study is limited to Lucknow; however, similar studies can also be conducted in other cities.
- The sample of this study was limited to class IX girls students, but future research can include different samples, such as students from other grade levels or boys.
- Additionally, the study was conducted with a sample size of 120 students; future research can involve larger sample sizes for more robust findings.
- This study focused on UP Board Hindi medium students; further research can include students from other boards and mediums.
- While this study used attitude as the dependent variable, future studies can explore other variables, such as motivation, achievement, or self-efficacy.
- Lastly, this study employed a quasi-experimental research design; future research can utilize different designs, such as randomized controlled trials or longitudinal studies, to enhance the reliability and applicability of the findings.

These avenues for further research will help build a more comprehensive understanding of the factors influencing attitudes towards STEM education and inform strategies to foster greater inclusion and diversity in these critical fields.

Future Plans for Dissemination of Research Outcomes

The Attitude scale used in the present study is currently in Hindi. The researcher will develop a bilingual version of this scale to cater to a wider sample. To ensure the tools effectiveness and reliability, it will be standardized with appropriate norms. The researcher will then publish the standardized bilingual scale. This effort is particularly significant due to the existing lack of tools specifically designed to measure the attitude of girls towards STEM Education. By providing the robust and accessible attitude scale the researcher aims to facilitate more comprehensive studies and Interventions in this area.

The researcher will try to coordinate with available government agencies working in the field of secondary education and science education like NCERT, SCERT, DIETs, DST etc. to make available the developed the intervention program on their platforms to ensure its wider usage. The goal is to make this program available to a broader sample, particularly targeting educational institutions and policy makers. By integrating the activities included in this intervention program into the curricula and training modules, will significantly contribute to enhancing the attitude of girls' students towards STEM Education. This dissemination strategy aims to foster a more positive and supportive environment for girls in STEM, ultimately encouraging greater participation and success in these fields.