# Title: Integrating STEAM Education in a Boys' School: A Case Study of Government Higher Secondary Schools (GHSS), Fatima, Mardan

***By Anum & Ahmad Hayat***

# Table of contents:

## Policy Statement:

A policy should be established to introduce STEAM education in Government Higher Secondary Schools (GHSS), especially in rural areas. Schools should have the necessary resources, including science labs, technology tools, and teacher training programs. The curriculum should focus on hands-on learning to develop students' problem-solving and critical thinking skills and to integrate STEAM education. Government support is essential for funding, teacher development, and curriculum updates. Regular assessments should be conducted to monitor progress and improve the implementation of STEAM education in rural schools.

**Abstract:** The education system in Pakistan, particularly in public schools, often emphasizes traditional teaching methods that neglect practical skills and creative thinking, especially in STEAM (Science, Technology, Engineering, Arts, and Mathematics) education. This study introduces a STEAM program at Government Higher Secondary School (GHSS) Fatima in Mardan, Pakistan, aiming to enhance students' creativity, practical skills, and interest in STEAM while promoting gender equality. Using a mixed-methods approach, data was collected through student questionnaires, interviews with teachers and the District Education Officer (DEO), and Focus Group Discussions (FGDs) with parents and students. A STEAM workshop was conducted to evaluate the impact of hands-on learning, revealing a 30% increase in student interest in STEAM subjects and a 25% improvement in problem-solving skills. Despite challenges such as resource limitations and resistance to change, the program demonstrated significant student engagement and creativity. The findings highlight the potential of STEAM education to transform traditional classrooms and provide a framework for implementing similar programs in other schools, emphasizing hands-on learning, creativity, and equitable access for all students.

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## 1. Introduction

Education in Pakistan faces many challenges. One major issue is the use of outdated teaching methods. Another problem is the lack of focus on modern disciplines like Science, Technology, Engineering, Arts, and Mathematics (STEAM). STEAM is an educational approach that combines these subjects. It helps students develop critical thinking, creativity, and problem-solving skills. However, STEAM education is rarely implemented in Pakistan's government schools. Government schools often lack the resources to support modern teaching methods. They also follow traditional curricula that do not encourage creativity or hands-on learning. As a result, students struggle to develop skills needed for the future **(Zubair & Shah, 2014)**. This study addresses a key gap: the lack of STEAM education in government schools. The research question is: How can a STEAM program be implemented in a government school to improve students' skills and ensure equal opportunities for all?

The Khyber Pakhtunkhwa (KP) government is working to improve education by using technology and new ideas in schools. As part of the Khyber Pakhtunkhwa Education Sector Plan (ESP) 2020/21 – 2024/25, programs like the Distance Learning Program help students build digital skills and prepare for the future. KP has also started STEAM courses in some schools, allowing students to learn through hands-on activities in science, technology, engineering, arts, and math. To make sure more students have access to digital learning, the government has introduced digital literacy programs in many elementary and secondary schools. These programs help students develop the technology skills they need to succeed.

Another important project is the STEM Education Project, which focuses on public schools. It helps students connect what they learn in books with real-life skills, making learning more useful. With these efforts, the KP government is building a learning system that encourages students to think critically, solve problems, and be creative, so they are ready for future education and jobs (Khyber Pakhtunkhwa Education Sector Plan, 2020/21 – 2024/25).

## 21st-century skills

In today's rapidly evolving world, it is essential to equip our youth with the knowledge and skills necessary to tackle complex problems. Research indicates that students will increasingly require 21st-century skills such as creativity, critical thinking, communication, and collaboration that many currently lack, particularly in mathematics, technology, and science subjects **(Morrison, 2015)**. STEAM encourages students to work together, share ideas, and think outside the box. This helps them develop a well-rounded mindset and get ready for careers in fields like content creation, writing, graphic design, marketing, programming, and more. A systematic review found that implementing

STEAM education in schools positively affects learners' learning achievement, affective factors, and developmental skills(Hwang & Lai, 2022). By focusing on 21st-century skills through STEAM, students can succeed in their future careers and make a real impact in the world.

**WHY ARTS?**

Arts are often undervalued in traditional educational systems , particularly in areas facing significant resource limitations, where the focus tends to prioritize science, technology, engineering, and mathematics (STEM). This narrow emphasis can lead to a lack of creativity and critical thinking skills among students, which are essential for innovation and problem-solving in the 21st century. However, integrating arts into STEM to form STEAM (Science, Technology, Engineering, Arts, and Mathematics) has gained global recognition as a way to foster a more holistic and engaging learning environment. In regions like Fatima, Mardan, Pakistan, where educational resources are often limited, the inclusion of arts can transform STEM education by making it more relatable, creative, and accessible to students.This paper examines how incorporating arts into STEM can boost creativity, critical thinking, and student engagement in resource-constrained settings. It analyzes the challenges of STEM education in Fatima, Mardan, such as limited resources, inadequate infrastructure, and a lack of trained teachers, and also highlights how the integration of arts can help address these challenges. For example, activities like drawing, painting, music, and drama help students visualize abstract scientific concepts and approach problems from multiple perspectives. Successful initiatives, such as Robotics and Art Week, where students create "ArtBots," demonstrate how combining art and technology can make STEM more engaging and inclusive. By incorporating locally relevant art forms and cultural practices, educators can create a more meaningful learning experience that prepares students for the complexities of the modern world

Integrating arts into STEAM education is not just an enhancement; it is a necessity for bringing up well-rounded, innovative, and adaptable learners. In schools in Fatima, Mardan, where educational resources and opportunities are often limited, but incorporating arts can transform the learning experience more fun and interesting, this can help students with the skills they need to succeed in a rapidly changing world. By including the arts as a important component of STEAM, educators can cultivate

creativity, critical thinking, and collaboration, preparing students for a brighter future.

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## 1. STEAM Education

“STEAM” is a shortcut for for subjects : Science, Technology, Engineering, Arts, and Mathematics , and these subjects teaches students how to apply knowledge in practical ways. According to **Papadopoulou (2024)** STEAM helps students develop problem solving skills which are important and creativity by adding the Arts into “STEM” subjects. These subjects are important for preparing students for future challenges that comes in their life's. **How and Hung (2019)** discuss the role of Artificial Intelligence (AI) in STEAM, saying it can change how STEM is taught by creating adaptive learning environments, teaching students about AI can improve their problem solving skills more. **Suslenco (2024)** agrees adding that STEAM not only promotes technology but also helps create a diverse workforce aligned with sustainability goals.

### 2. Challenges in STEAM Education

Even though STEAM has many benefits but there are challenges in its implementation especially in countries like Pakistan mostly in rural area . **Malik (2016)** talks about problems that are faced in STEAM education in Pakistan such as reliance on rote learning and a lack of practical work in the curriculum and because of that there is the lack of interest. Pakistan’s education system is divided into two stages, which limits students' exposure to interdisciplinary learning and reduces creativity and intrest . **Hali et al. (2020)** mention that teachers often use outdated methods making it hard to introduce STEAM education. In Pakistan cultural expectations and gender roles also limit opportunities specially for women and girls in STEM while many of them take there fields but in home in “Arts” but not all them take interest in “ Arts” but still they didn’t get much opportunities . **Jan and Azeem (2024)** highlight these issues, especially in rural areas, where girls face extra challenges in accessing STEM education.

### 3. Global Comparisons and Trends in STEM Education

Around the world countries are using different approaches to STEAM education. Studies by **Campbell et al. (2022)** compare STEAM education in Sweden, Australia, and Belgium, showing how early STEAM policies impact students' interest in STEAM careers. These countries have addressed the decline in STEAM interest by creating structured policies and curricula which can offer lessons for Pakistan. **Leung (2020)** presents a teaching model that links different subjects together, which could work in Pakistan by bridging the gap between traditional education and modern approaches. **Wahono et al. (2020)** show that STEM

teaching methods improve student learning and they find it fun and intresting, and **Li et al. (2020)** note a global push for more STEAM integration.

## 4. Technology and ICT Integration in Education System

Integrating Information and Communication Technologies (ICT) into education is essential for advancing STEAM. **Zamir and Thomas (2019)** explain that teachers' attitudes toward ICT influence how well they use technology in the classroom. They stress the importance of training teachers to use technology effectively in STEAM education. **Lai and Bower (2019)** also mention that it is important to assess how ICT impacts student engagement and learning outcomes.

STEAM education is becoming more important for developing the skills needed in today's world. While global trends show progress in integrating STEAM, challenges remain, especially in places like Pakistan where traditional methods and cultural barriers exist. Despite these challenges, STEAM's potential benefits such as promoting creativity, critical thinking, and inclusivity make it a valuable educational approach. To succeed, educators and policymakers need to focus on overcoming these challenges by providing training for teachers, encouraging interdisciplinary learning, and integrating technology into classrooms and schools in rural areas which not only help students but also teacher.

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## 3. Methodology

This study uses a mixed-methods approach to explore the challenges and opportunities of introducing STEAM (Science, Technology, Engineering, Arts, and Mathematics) education in a boys' school. The research was conducted at GHSS Fatima Mardan, selected as a representative case study due to its typical context as a boys' school with limited prior exposure to STEAM education. A purposive sample of 8 students was chosen based on their interest and performance in STEAM subjects, ensuring they could provide meaningful insights. Additionally, unstructured interviews were conducted with teachers, parents, and the District Education Officer (D.E.O) to gather diverse perspectives on the implementation of STEAM education. Data was collected through pre- and post-surveys and unstructured interviews. The surveys measured changes in students' attitudes and understanding of STEAM before and after watching an explanatory video. The interviews explored stakeholders' views on the potential benefits, challenges, and practical considerations of implementing STEAM education. Thematic analysis was used to identify recurring themes in the qualitative data, while quantitative data from the surveys were analyzed to identify trends.

Ethical considerations, such as informed consent and confidentiality, were strictly followed to ensure the research was respectful and fair. This mixed-methods approach provided a comprehensive understanding of the potential for STEAM education in the school context

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## 4. Findings

STEAM education in boys' schools at Government Higher Secondary Schools (GHSS) in Fatima Mardan, shows both opportunities they had and challenges they faced. This section shares findings from student surveys and stakeholder interviews, shows how STEAM education improves creativity, critical thinking, and interest in STEM subjects, while also highlighting barriers to its success.

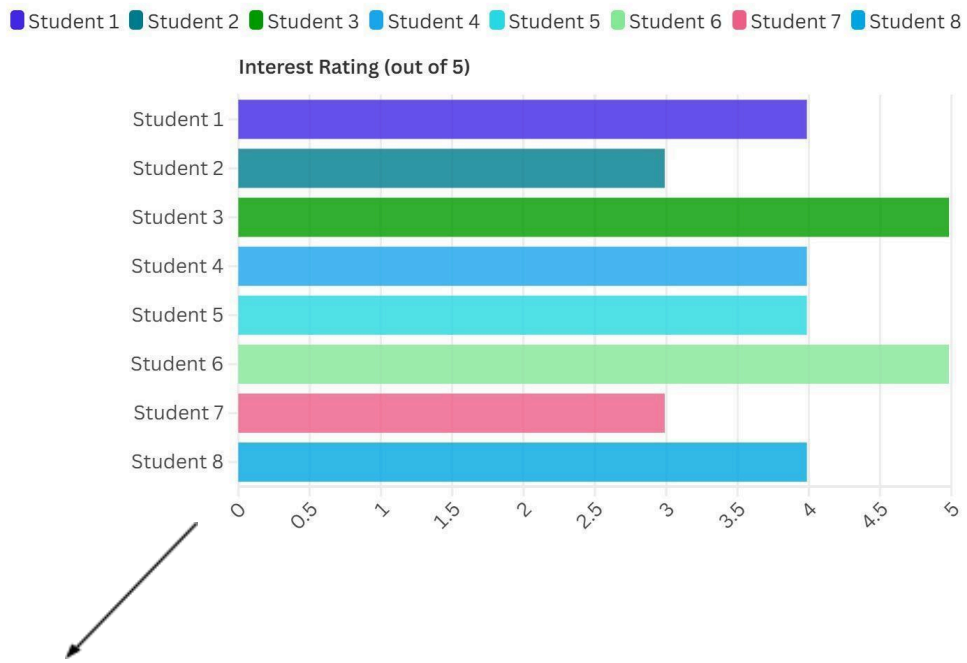
### **Stakeholders**:

Eight students aged 14 to 15 from 9th grade were selected, along with three parents, to gather comprehensive data. Un-structured Interviews were conducted with these students, their parents, three teachers, and the District Education Officer (DEO) of a school in Mardan, KPK.

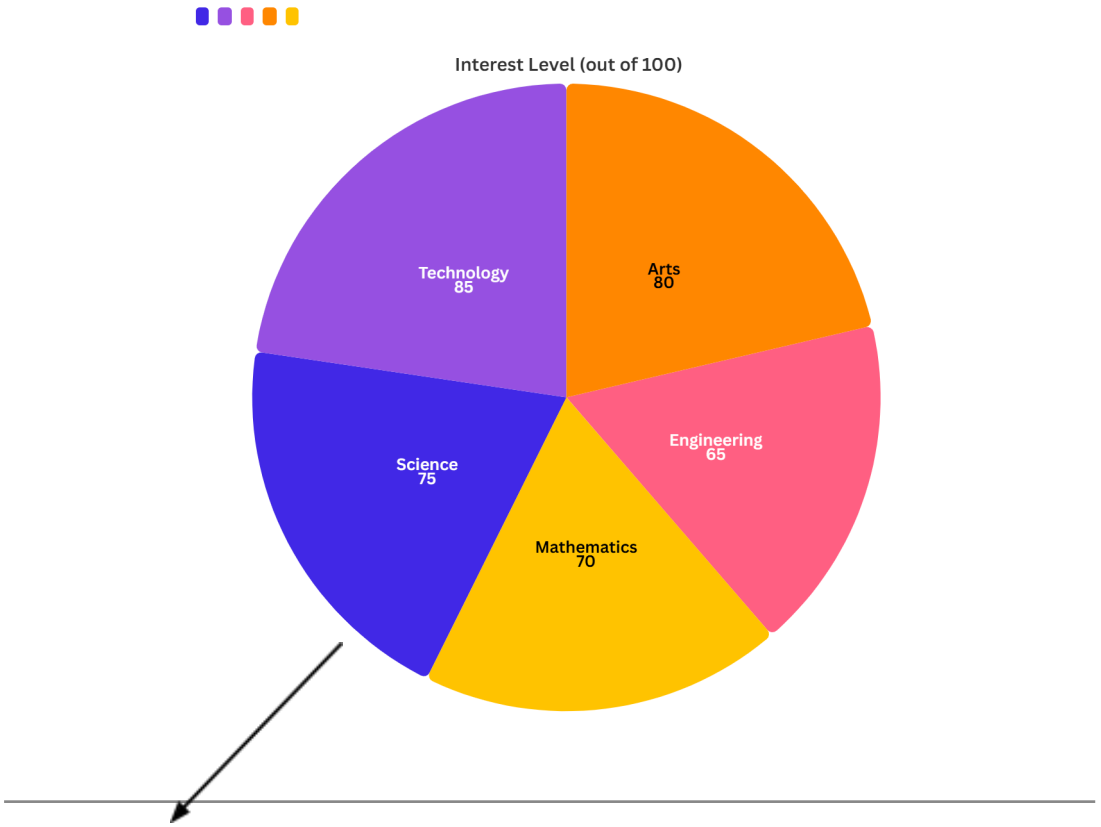
## 1. Students' Interest in STEAM Subjects

The survey of 8 students showed a heightened interest in STEAM subjects and future career once interactive and practical activities were introduced. Science and technology related subjects were rated as "engaging" by many of respondents. Students highlighted that the integration of arts helped them and they had interest and they can think creativity " out of the box". Many said that Concepts in mathematics and science are much harder for them and when they do an experiment or any activity related to their subject it make these subjects more interesting making these subjects more relatable.

- **Student Interest In Subjects**




NOTE: The chart shows students' interest in STEAM subjects on a scale of 1 to 5. Most students rated 4, while Student 3 and Student 6 gave the highest rating of 5. Students 2 and 7 showed moderate interest with a rating of 3.




Note: This pie chart represents students' interest levels in STEAM subjects Science, Technology, Engineering, Arts, and Mathematics measured out of 100.

**Creativity and Critical Thinking**

“Art projects help me think in new ways, and I enjoy solving problems creatively,” shared one student. Many students reported that occasional art activities and hands-on projects, such as practical experiments and group tasks, helped them develop problem-solving skills. These activities, especially in mathematics and arts, encouraged them to think creatively. For instance, students expressed enthusiasm for art-based assignments where they designed solutions for environmental issues.

**Gender Barriers**

Gender roles significantly impact education in Mardan Fatima, with boys, girls, and transgender students facing different challenges. A teacher noted, *"Many girls drop out because their families believe household work is more important than education, but some boys also leave to work and support their families."* Early marriages and safety concerns further limit girls' schooling opportunities. Financial struggles force many students out of education, but societal expectations shape whether they

stay home or enter the workforce. Meanwhile, transgender students face even greater barriers, as one teacher stated, *"There are no schools for them here, so they are completely left out of the education system."* These insights highlight the urgent need for inclusive and gender-responsive educational opportunities for all children.

## 2. Stakeholders' Perspectives

### School Administrators

Interviews with school D.E.O and teachers shows their optimism about the potential of STEAM education. They acknowledged that this approach could address rote learning practices prevalent in the region and many students can choose the career fields which they want . However, concerns were raised about the lack of trained more then the resources but still the resources where not in use.

### Teachers

Teachers appreciated the emphasis on integrating arts into STEM subjects which can increase there interest in Studies, noting that this approach made teaching more dynamic. However, they also expressed challenges, such as:

> Limited professional development opportunities to acquire STEAM-specific teaching methodologies.
>
> The resources provided were not widely used because many students were unaware of how to use them, and teachers lacked the necessary training to integrate them effectively into their teaching.

### Parents

Parents expressed mixed reactions. While many recognized the value of STEAM education in preparing their children for modern careers others were skeptical about its relevance in a curriculum dominated by board examinations. Financial constraints also emerged as a barrier, with parents prioritizing core subjects over innovative programs and also included the gender barriers.

## 3. Challenges to STEAM Integration

### Resource Constraints

Schools in Fatima, Mardan, lack adequate resources such as laboratory equipment, art supplies, and digital tools essential for STEAM activities. Teachers included that resources are available but they aren’t much aware about the uses. One teacher stated, *"We have some equipment, but we don’t know how to use it properly for STEAM activities. It just sits*

*there unused."* Another teacher added, *"Even when we have art supplies or digital tools, we lack the training to integrate them into our lessons effectively."* This highlights the gap between resource availability and their practical application.

**Teacher Training**

The absence of specialized training programs for teachers was identified as a critical gap. Teachers expressed difficulty in adopting interdisciplinary teaching approaches, particularly integrating arts into STEAM subjects and the Use of resources. A teacher include:*"I struggle to use the resources we have because I don't have the skills or confidence to make them work in a STEAM context."*

**Curriculum Rigidities**

The existing curriculum is heavily exam-oriented, leaving little room for the creative exploration central to STEAM education. Stakeholders emphasized the need for curriculum reforms to incorporate project-based and inquiry-driven learning. The coordinator of ninth class stated that *"We're constantly under pressure to finish the syllabus and prepare students for tests. There's no space for experimentation or art activites."*

**Societal Attitudes**

Cultural norms in the region often prioritize traditional career paths, discouraging creative and scientific pursuits. This societal mindset poses a barrier to the acceptance of STEAM education as a viable learning approach. One of the Science teacher noted, *"Parents here want their children to become doctors or engineers"*.

## 4. Potential of STEAM Education

**Skill Development**

STEAM education was found to promote a range of skills, including critical thinking, collaboration, and communication skills. Students participating in group projects reported enhanced teamwork abilities, while art-based assignments improved their expression and creativity and in the schools many students have leadership skills.

**Enhanced Career Aspirations**

Exposure to STEAM subjects expanded students' awareness of non-traditional career paths in technology, engineering, and design. Some students expressed aspirations to pursue fields such as robotics, environmental science, and graphic design, which were previously unfamiliar to them before the session.

## 5. Recommendations from Stakeholders

**For Schools**

Develop resource-sharing models among schools to optimize available materials and equipment.

Additionally, schools can establish **STEAM hubs**—dedicated spaces equipped with modular furniture, digital tools, and art supplies to support interdisciplinary learning and hands-on projects. To further engage students, schools can form **STEAM clubs** like arts and robotics, structured with weekly meetings for collaborative projects, skill-building activities, and competitions. These clubs would require basic resources like art supplies, robotics kits, computers, and dedicated spaces, while competitions could be organized at the school or regional level to encourage creativity and innovation. This integrated approach ensures efficient resource use, fosters collaboration, and promotes a culture of STEAM learning.

**For Teachers**

Implement continuous professional development programs focused on STEAM methodologies and teacher training.
Encourage teacher collaboration to share best practices and lesson plans.

**For the Community**

Conduct awareness campaigns to change societal perceptions about STEAM careers.
Involve local industries in mentoring programs to expose students to practical applications of STEAM disciplines .

The findings shows the transformative potential of STEAM education in enhancing creativity, critical thinking, and career aspirations among students in boys' schools in Fatima, Mardan. While significant challenges remain, such as societal attitudes, targeted interventions can pave the way for equitable and effective STEAM education. These insights lay the foundation for future initiatives aimed at integrating STEAM education across Pakistan's diverse educational landscape and also shows that many stakeholders are not just interested but also excited.

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The success of STEAM education also depends on the active involvement of school teachers, parents, principal and policymakers each fulfilling distinct and impactful roles .

**School Teachers and Principle :** Teachers and principals play an important role in Integrating STEAM education in schools. Teachers help students learn by making lessons interesting and connecting subjects like science, technology, engineering, arts, and maths. They can encourage students to think creatively and solve problems and provide them with activities which can make it interesting and fun and the more the lesson is interesting the more will students like to learn more and they will participate more in their classes while not only supporting students but also teachers so, Principals should arrange workshops and training to help teachers learn how to teach STEAM and use resources properly.. They can also work to bring new ideas and tools to the school to make STEAM education successful. Together, teachers and principals help students explore and enjoy learning in a fun and meaningful way which can not only help students but also teachers .

**Parents:**Parents engagement plays very crucial role in the success of STEAM programs and it directly impacts the student's learning experience also. When parents are actively involved they can help challenge outdated ideas about the role of the arts in education and encourage excitement about integrated learning models. This involvement can be especially important because it shows the students that their learning is valued not only by their teachers but also by their families and they can take more interest **(Nelson et al., 2024)**.

One effective way to bring up this engagement is through activities in STEAM or like having fairs or hands-on workshops. These events give parents the opportunity to connect with the program's vision and see firsthand how STEAM education blends science, technology, engineering, arts, and mathematics. By participating in such activities, families can gain a deeper understanding of how creative and innovative the interdisciplinary approach can be. These events also provide a space for parents to see the potential of STEAM education in inspiring their children and helping them develop critical thinking and problem-solving skills in exciting new ways.

**Policymakers:** Policy makers are important because They establish the groundwork for systemic change. Their contributions in funding STEAM initiatives, developing progressive policies, and advocating for teacher training are very important. Collaborations among government entities, and the private sector can strengthen these efforts, creating a supportive ecosystem for STEAM education at the national level.

In summary, their combined efforts of these stakeholders are very essential for the successful implementation and sustainability of STEAM education and for the students.

## 6. Conclusion

This study shows the opportunities and challenges of implementing STEAM education in a boys' school, focusing on GHSS Fatima, Mardan. Using a mixed-methods approach, the research include surveys and unstructured interviews to gather more information from students and key stakeholders, including teachers, D.E.O, and parents. The findings highlighted both the potential and limitations of introducing STEAM in the context of a resource-constrained school environment.

The analysis revealed that students showed a positive attitude toward STEAM subjects and expressed curiosity and interest in this interdisciplinary learning approach. However, significant challenges emerged, including limited teacher training, underutilized resources, and a lack of awareness about STEAM among stakeholders. Despite these barriers, the study identified opportunities for STEAM to enhance creativity, critical thinking, and interest in STEM careers.

The integration of STEAM at GHSS Fatima can be considered partially successful, as evidenced by students' enthusiasm and interest in STEAM subjects. However, the lack of teacher preparedness and resource utilization indicates that more work is needed to fully realize its potential. Gender-specific insights from this boys' school suggest that STEAM education can effectively engage male students, but further research is needed to explore its impact in mixed-gender or girls' schools to ensure equitable access and outcomes.

Key lessons learned include the importance of teacher training, effective resource management, and stakeholder awareness campaigns to support STEAM integration. These findings emphasize the need for targeted interventions, such as professional development programs for teachers, better utilization of available resources, and initiatives to promote STEAM education among parents and the community. By addressing these challenges, STEAM can play a transformative role in equipping students with the skills needed for the future.

This research provides a foundation for further studies and policy development aimed at fostering equitable and effective STEAM education in similar school settings, particularly in government schools serving all genders. Future research should explore the gender dynamics of STEAM education and identify strategies to ensure inclusivity and equal opportunities for all students.

## Keywords

STEAM Education, STEM Education, Equitable Education, Creativity in Learning, Critical Thinking, Project-Based Learning, Thematic Analysis, Stakeholders, Survey, Semi-Structured Interviews, Gender Gap in STEM, Educational Policy, Inquiry-Based Learning, Interdisciplinary Learning, 21st-Century Skills.

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## Abbreviations

1. **STEAM** – Science, Technology, Engineering, Arts, and Mathematics
2. **STEM** – Science, Technology, Engineering, and Mathematics
3. **PBL** – Project-Based Learning
4. **GHSS** – Government Higher Secondary School
5. **ICT** – Information and Communication Technology
6. **NGO** – Non-Governmental Organization
7. **UNICEF** – United Nations International Children's Emergency Fund
8. **MOE** – Ministry of Education
9. **DEO** – District Education Officer

## Glossary

1. **STEAM Education** – An educational approach that integrates science, technology, engineering, arts, and mathematics.
2. **STEM Education** – A learning model focusing on science, technology, engineering, and mathematics.
3. **Equitable Education** – Ensuring all students receive fair access to learning opportunities.
4. **Creativity in Learning** – Encouraging students to think in innovative and imaginative ways.
5. **Critical Thinking** – The ability to analyze information logically and make reasoned judgments.
6. **Project-Based Learning (PBL)** – A teaching method where students gain knowledge by working on real-world projects.
7. **Thematic Analysis** – A research method used to identify and analyze patterns in qualitative data.
8. **Stakeholders** – Individuals or groups involved in or affected by educational decisions (e.g., students, teachers, parents, policymakers).

9. **Survey** – A method of collecting data from a group of people using structured questions.
10. **Semi-Structured Interviews** – A research technique that combines fixed questions with open-ended discussions.
11. **Gender Gap in STEM** – The disparity between male and female participation in STEM fields.
12. **Educational Policy** – Rules and regulations that shape the education system.

13. **Inquiry-Based Learning** – A student-centered approach where learning happens through questioning and exploration.
14. **Interdisciplinary Learning** – Teaching that integrates multiple subjects to provide a broader understanding of concepts.
15. **21st-Century Skills –** Essential skills like collaboration, communication, problem-solving, and digital literacy.

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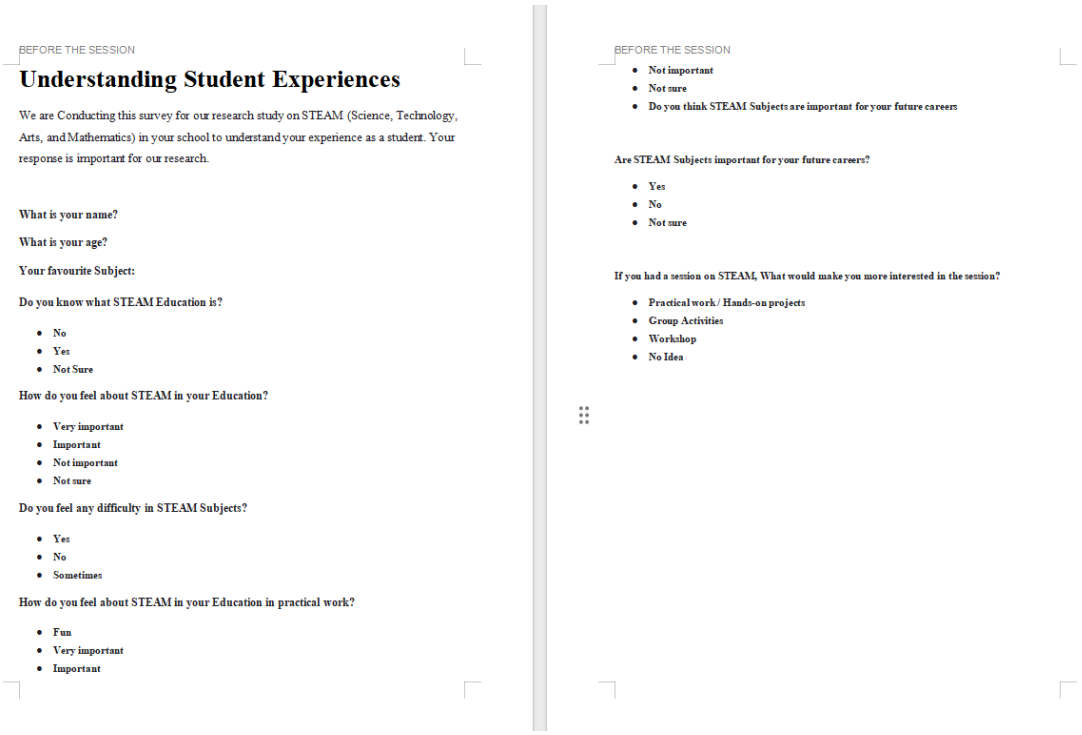
19. (D.E.O Number: +92 307 8446037) For any information

20. Principal of the school contact Number: 03363084818

21. Teacher of the school contact number: 03409795436

- **Student Before the Session Survey**



BEFORE THE SESSION

**Understanding Student Experiences**

We are Conducting this survey for our research study on STEAM (Science, Technology, Arts, and Mathematics) in your school to understand your experience as a student. Your response is important for our research.

**What is your name?**

**What is your age?**

**Your favourite Subject:**

**Do you know what STEAM Education is?**

- No
- Yes
- Not Sure

**How do you feel about STEAM in your Education?**

- Very important
- Important
- Not important
- Not sure

**Do you feel any difficulty in STEAM Subjects?**

- Yes
- No
- Sometimes

**How do you feel about STEAM in your Education in practical work?**

- Fun
- Very important
- Important

BEFORE THE SESSION

- Not important
- Not sure
- Do you think STEAM Subjects are important for your future careers

**Are STEAM Subjects important for your future careers?**

- Yes
- No
- Not sure

**If you had a session on STEAM, What would make you more interested in the session?**

- Practical work / Hands-on projects
- Group Activities
- Workshop
- No Idea

- **Student After the Session Survey**

After the Session

## Understanding Student Experiences: STEAM Education Survey (Post-Session)

We are surveying to appreciate your experience with the recent STEAM session. Your feedback is crucial for our research, and we appreciate your participation.

**What is your name?**

**What is your age?**

**What is your favourite subject after the STEAM session?**

**How familiar were you with STEAM education before the session?**

- Not familiar
- Somewhat familiar
- Very familiar

**After the session, how important do you think STEAM is in your education?**

- Very important
- Important
- Not important
- Not sure

**Did you find any difficulty in the STEAM subjects during the session?**

- Yes
- No
- Sometimes

**How did you feel about the STEAM session's practical work (hands-on activities)?**

- Fun
- Very important
- Important
- Not important
- Not sure

**After the session, do you believe STEAM subjects are important for your future career?**

- Yes
- No
- Not sure

**What would make you more interested in future STEAM sessions?**

- More practical work / Hands-on projects
- Group activities
- Workshops
- No idea