

# **IMPLEMENTATION OF STEAM EDUCATION: A CASE STUDY OF SECONDARY SCHOOLS IN BANGLADESH**

Thesis

Submitted to meet the Graduation Requirements of  
Master's Degree MA in Education



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## ABSTRACT

The purpose of this study is to look into the state of STEAM education implementation in Bangladeshi secondary schools at the moment together with challenges and opportunities associated with implementation of STEAM education, and the attitudes and perceptions of teachers and students towards implementation of STEAM education in Bangladesh. This study employs a qualitative research methodology, utilizing three distinct methods of data collection: focused group discussions, interviews, and observations. Triangulation techniques are employed in the process of data collection and sourcing to enhance the validity and reliability of findings, thereby bolstering the credibility and trustworthiness of the research. For the observational component of this case study, a private English-medium school located in Dhaka, Bangladesh, was chosen. The present study recruited a sample size of 21 participants. The participants of the interview comprised a District Education Officer and two school principals, one from a public secondary school and the other from a private secondary school situated in Bogura, Bangladesh. A series of focus group discussions were undertaken, involving a total of six teachers and twelve students who were selected as representatives from the aforementioned schools not having a STEAM curriculum. The findings indicate that 1) STEAM education is not currently offered in secondary schools throughout Bangladesh. Principals and teachers of secondary schools believed that integrating STEAM education into Bangladesh's educational system will help students in developing skills like problem-solving, critical thinking, and teamwork. To the contrary, more teacher development programs and policy implementation would be needed to properly implement STEAM education. 2) The implementation of STEAM education will provide learners and teachers with both possibilities and challenges. The study discovered that teacher training, a limited budget, and STEAM lab accessories can be a challenge for secondary school teachers. Teachers, on the other hand, would benefit from increased professional development opportunities, the establishment of strong cross-disciplinary collaborations, and the efficient use of educational technology. 3) Secondary school teachers and students both perceived STEAM education as offering real-world experiments and inquiry-based learning. Teachers felt that professional development was necessary before STEAM was put into effect in Bangladeshi classrooms. The study sheds important light on the function of secondary school STEAM programs in defining future options for students by examining the post-secondary routes of STEAM-educated students. The research findings will not only enrich the dialogue on STEAM education in Bangladesh but also serve as a foundation for policy reform aimed at modernizing and enhancing the country's educational system for a better future.

**Keywords:** *STEAM Education, Secondary Schools, Educational Policy, Learning Strategies, Educational Reform*

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## ABBREVIATION

|       |   |
|-------|---|
| STEAM | Science, Technology, Engineering, the Arts, and Mathematics |
| STEM  | Science, Technology, Engineering, and Mathematics           |
| NCLB  | No Child Left Behind  |
| ELA   | English language arts                                       |
| RISD  | Rhode Island School of Design                               |
| NSF   | National Science Foundation                                 |
| SMET  | Science, Mathematics, Engineering, and Technology           |
| AR    | Augmented reality   |
| CK    | content knowledge   |
| PK    | pedagogical knowledge                                       |
| VR    | virtual reality   |
| PCK   | Pedagogical Content Knowledge                               |
| PD    | Professional Development                                    |

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# **CHAPTER I:**

## **INTRODUCTION**

Chapter I provides an overview of the science, technology, engineering, arts, and mathematics (STEAM) education, accompanied by the background of this research. It also elucidates the research aims and questions of the study. In the subsequent paragraphs, a more detailed discussion is presented regarding each of the aforementioned topics.

### **1.1. Background of the Study**

Before going into STEAM education and its arrival into secondary schools, it's worth mentioning to talk about the STEM (Science, Technology, Engineering and Mathematics). The coming of STEM education into surface dates back to the time when Russian launch their Sputnik satellite into the space and brought a fear of falling behind in the United States of America (Mohr-Schroeder et al., 2015) More precisely, the United States targeted to develop engineers and scientists to bring about a revolution in the world of science and technology. Since then, STEM education has been introduced in most of the country to tackle issues that requires science, technology, engineering and mathematics. Now, let see what is STEM education.

STEM, an acronym for science, technology, engineering, and mathematics, is a prominent topic in education, industry, innovation, and competition worldwide. The word refers to students from preschool to post-graduation levels and describes occupations in specific disciplines (Marrero et al., 2014). The importance given to STEM education lays in preparing future youth with enhanced understanding and skills in of scientific innovations and engineering excellence.

In addition to STEM curriculum advancements, educators emphasize the importance of equipping young people with 21st-century abilities such as creativity, innovation, and entrepreneurship for future success. There was a rising discussion among educators to include “arts” in STEM curricula to promote creativity and innovation (Guyotte et al., 2014). The addition of arts and design can transformed STEM into STEAM (Liao, 2016). Ge, Ifenthaler, and Spector (2015) define STEAM as integrating liberal arts and humanities into STEM education. Some STEAM concepts utilize the ‘A’ to signify a fifth field, arts and humanities. STEAM (science, technology, engineering, arts, and mathematics) is a new discipline that aims to deliver a well-rounded education (Rolling, 2016).

In its development, STEAM becomes a new discipline that aims to deliver a well-rounded education (Rolling, 2016). Education that stresses STEAM combines academic knowledge with hands-on experience and real-world applications (Yakman, 2008). STEAM education has been shown to improve students' interest, critical thinking, and ability to solve problems (Bertrand & Namukasa, 2020). This is in addition to preparing children for the 21st century job, which can improve the quality of education in this current era if they bring in STEAM education at the secondary level (Sarkar, 2021).

The Fourth Industrial Revolution is elevating STEAM education (Jesionkowska et al., 2020). Today's schools commonly discuss STEAM education (Bahri et al., 2017). STEM preceded STEAM. STEAM combines STEM with the arts, including language arts, dance, theater, music, visual arts, design, and news media (Huser, 2020). STEM emphasizes science (Ugras, 2018), STEAM teachers can inspire lifelong learning in their kids by integrating them in arts and sciences. STEAM subjects include science, technology, engineering, art, and math (Khine & Areepattamannil, 2019).

The promise of STEAM education is receiving more and more attention from academics and practitioners in the field of education. There has been substantial research on the STEAM education idea, teaching methods, instructional design, and other aspects (Wu et al., 2019). According to Zhang et al. (2022), a STEAM education innovation involves varied schools participating in various activities. The majority of research findings affirm the importance of STEAM education and list a number of advantages, including improved teamwork, increased creativity, and the development of scientific inquiry abilities (Guyotte et al., 2015; Zhang et al., 2017).

Many schools view the arts as a distinct subject that only a select group of gifted or affluent students' study (Daugherty, 2013). It is the belief of proponents of the STEAM movement that the arts may be incorporated into a comprehensive curriculum in which students study all topics to develop their capacity for creative problem-solving (Liao, 2016). Learning only occurs when students are actively involved in something (Freeman et al., 2014). Most students might not be engaged in learning material or passing exams without real-world applications. However, using a transdisciplinary approach enables students to gain new information about their ability to influence their memory, collaboration, and creative problem-solving skills through deep engagement with the material (Hardiman et al. 2009).

The majority of teachers in the present day agree that STEAM instruction as well as a fundamental comprehension of the underlying ideas, this method is consistent with earlier STEAM education theories (Quigley, et al., 2017; Yakman, 2010), but rather than giving a clear and coherent description of STEAM teaching, teachers appear to be more interested in the qualities that come as a result of STEAM instruction than in offering specific content-related STEAM instruction in the classroom.

Education in Bangladesh is changing to match the global standards and workforce needs of the 21st century (Lombardi & Oblinger, 2007). Urban and rural schools are integrating technological systems. Bangladesh's art and culture, which combines traditional music, dance, and handcraft, create a vibrant and enriching environment (Bari, 2017). In Bangladesh, education is a driving force behind development, integrating technology and promoting a more promising future where learning and art coexist but educational systems are lacking (Shahriar et al., 2021) To overcome this teachers should use the STEAM framework instead of traditional teaching techniques to provide opportunities for students simultaneously.

Students are better prepared to work in the fields where there is expected to be significant growth because STEAM teaches them how to think critically, solve issues creatively, and apply their creativity (Wu et al., 2022). Chowdhury et Al. (2020) mentioned that STEM has not yet been fully introduced in Bangladesh's educational curriculum. Digital Bangladesh ICT Education attempts to improve digital literacy in students and educators so they can use technology for learning and communication (Karim, 2010). Although technology education is active due to Covid-19, there are still gaps and numerous challenges (Farhana et al., 2020).

With the growing interest on research about STEAM, This study aims to discuss STEAM education in Bangladesh. Since the country's independence from Pakistan in 1971, Bangladesh has undergone substantial changes in its educational system. Bangladesh was formerly a part of Bengal in Northeast India and was once known as East Pakistan from 1947 to 1971 before adopting its current name (Mousumi & Kusakabe, 2021).-In Bangladesh, primary education consists of classes one through five, whereas secondary education covers grades six through twelve. According to Mousumi and Kusakabe (2021), students normally attend a junior secondary school from the sixth

through the eighth grade, a secondary school for the ninth and tenth grades, and a higher secondary school, sometimes known as college, for the eleventh and twelfth grades (Mousumi & Kusakabe, 2021).

The evaluator at the school where the secondary school programs are being evaluated must collaborate with teachers and administrators there to improve the program. Because of this, the new education strategy will involve reforming traditional secondary education and developing an ICT-based educational system. The emphasis will be on STEAM, allowing students to gain theory-based practical knowledge in secondary school (Belbase et al., 2022).

Once they enter secondary school, pupils have a wide selection of options to select from, including but not limited to a range of fields, including but not limited to Bangla, English, Math, Global Studies, Agriculture, Religious Studies, Physical Education, ICT, Science Education, Business Studies, and Humanities. In grades 9–10, students must take one elective from the humanities, the sciences, or business. Students can select from any of the Science, Humanities, or Business Studies groups as part of their general education. Students are not permitted to seek additional science education later in their course of study if they choose a non-science path at the secondary level that is Humanities or Business Studies (Chowdhury & Sarkar, 2018).

Certain schools in Bangladesh have certain issues, the presence of which could improve the quality of education (Khan et al., 2014). Rahman et al. (2010) claim that the school system has been reformed such that just grades 6 through 10 make up the Secondary education level. Previously, classes 6 through 8 were considered Junior Secondary, while grades 9 and 10 were considered Secondary. On the other hand, the Bangladeshi Ministry of Education has stopped the primary or PEC (Primary Education Certificate) and junior secondary examinations or JSC (Junior School Certificate) so that

the previous education policy is maintained so that the students are not overburdened (No PEC exam this year in line with JSC-JDC, 2022).

The Secondary School Certificate (SSC) exam, given by high school seniors, is Bangladesh's most important national test. Students' future success in school and the workforce depends on this test. Because of the quick pace of change in today's society, young people must be given the information and experience to properly manage difficult challenges. As 21st-century pupils will need a deep understanding of science, technology, and mathematics (Leite et al., 2020), Bangladesh's text-based education system has to be upgraded (Haider, 2022).

## **1.2. Research Aims and Questions**

The purpose of this study is to look into the state of STEAM education implementation in Bangladeshi secondary schools at the moment together with challenges and opportunities associated with implementation of STEAM education, and the attitudes and perceptions of teachers and students towards implementation of STEAM education in Bangladesh. This involves determining the degree to which the school, teachers, and students are prepared for STEAM integration, identifying the implementation difficulties and roadblocks, and examining possible advantages and effects on engagement and learning outcomes for students. Specific objectives include:

1. To explore the current state of STEAM education in Bangladeshi Secondary Schools from the perspectives of a district education officer and principals.
2. To identify the challenges and opportunities in implementing STEAM education in Bangladeshi Secondary Schools from the perspectives of teachers and students.

3. To explore the attitudes and perceptions of teachers and students towards STEAM education.

The research questions follow the research aims above. The research questions of this study are:

1. What is the current state of STEAM education implementation in Bangladeshi secondary schools from the perspectives of district education officer and principals?
2. What are the challenges and opportunities associated with implementing STEAM education in Bangladeshi secondary schools from the perspectives of teachers and students?
3. What are the attitudes and perceptions of teachers and students towards STEAM education in Bangladeshi secondary schools?

### **1.3. Significance of the Study**

The present study focused on exploring the current state of STEAM education in Bangladeshi secondary schools. The study's main focus was on the opportunities and problems associated with adopting STEAM education in secondary schools in Bangladesh. It also included an assessment of teachers' and students' attitudes and perceptions regarding STEAM education. The current study contributes to comprehension how teachers are supported and equipped to give STEAM instruction. Mainly highlighting the need for training and professional development for instructors, assisting them in strengthening their capacities for successfully instructing STEAM course. Similarly, the study also adds to the existing body of knowledge already known about STEAM education in the world, by providing the context of Bangladesh. While, the study can also act as a model for other developing nations that wish to incorporate

STEAM subjects into their educational systems in order to create a skilled and creative generation capable of addressing future issues. Finally, the study bridges the gap between students' expectations and future policy reformation. By addressing students' perceptions, the study can significantly offer policymakers insights to take into account when drafting STEAM education policy in the future.

## **CHAPTER II:**

### **THEORETICAL FOUNDATIONS**

Chapter II contains literature reviews and theoretical frameworks used in this study. The literature review consists of history of STEM, how it eventually changed into STEAM Education. Meanwhile, the theoretical framework focused on how STEAM Education viewed as the theoretical perspectives.

#### **2.1. Review of Literature**

The rapidly expanding global economy of the 21st century calls for workers who are knowledgeable in STEM fields (Liao, 2016; Hunter-Doniger & Sydow, 2016; Margot & Kettler, 2019). To better prepare K–12 students for the global economy, STEM education has evolved in the US. However, Herro et al. (2017) report that STEM workforce recruitment, training, and retention have failed despite several efforts due to problems into the implementation. It is because it does not integrate with art and humanities aspects. Hence, Herro et al. (2017) said incorporating arts into STEM topics is a new trend to attract, prepare, and retain students. Thus, STEM becomes STEAM, which is the arts-integrated STEAM education (Herro et al., 2017; Hunter-Doniger & Sydow, 2016). This form of education is viewed as a strategy for enhancing student outcomes and competencies in STEM fields. To aid in the development of students who can contribute creatively to STEM professions, K–12 schools across the nation are increasingly being exhorted to implement STEAM education (Margot & Kettler, 2019).

Regarding the definition of STEM education and the best ways to implement it in the classroom, not all academics and practitioners are in agreement (Gao et al., 2020). Even if STEM education is becoming more popular and well-known on a worldwide level, this still exists. The integration of theory and practice in STEM education has not been

successful (Bell, 2016). Supporting the argument, Shernoff et al. (2017) state that a novel idea for a STEM curriculum that integrates the arts has been put out as a potential remedy because of the difficulties that are inextricably tied to STEM education and the demand that students be prepared to meet the needs of the STEM workforce.

According to research conducted by Miah (2011), the separation of ninth-grade students into three groups—Science, Arts, and Commerce—impedes their learning because they only peruse the textbooks for their respective groups. Students in the science department have access to practical seminars, whereas students in other departments do not. In developing countries like Bangladesh, where everyone has access to modern information technology, the traditional education system is still in existence (Prodhan, 2016).

Science instruction varies by country, area, educational system, grade level, and teacher (Doil & Pietzner, 2023). Some themes and methods are universally accepted in current scientific education. Labs and experiments are crucial to science education where seeing scientific principles in action helps students understand them, which can teach students real-world applications of scientific topics (Shana & Abulibdeh, 2020). This enhances comprehension and develops teamwork, research, and presentation abilities.

### **2.1.1. The History of STEM**

STEM Education was earlier known as Science, Mathematics, Engineering, and Technology (SMET) Education (Sanders, 2009). This educational initiative is intended to increase students' employability by teaching them to think critically, thereby enhancing their ability to solve problems creatively. Students who participate in STEM education are viewed as having an advantage, regardless of whether or not they pursue higher

education (Butz et al., 2004), and as having an even greater advantage if they pursue STEM-related higher education.

In the past, STEM concepts were not incorporated into traditional educational settings, despite their widespread use in numerous sectors of the industry during the Industrial Revolution. The utilization of STEM in the creation of revolutionary inventions such as the light bulb, the automobile, tools, machinery, etc. was confined primarily to engineering establishments. Those who achieved these advancements typically possessed only a high school diploma or were enrolled in an apprenticeship program. In contrast, STEM education was almost nonexistent (Butz et al., 2004). These "giants" of creativity made some of the most significant advancements in human history possible by applying STEM principles.

According to White (2014), STEM especially mathematics have been the foundation of every student's education. Our classification: Science involves methodical observation, experimentation, and measurement to discover general rules that describe observed events. Technology studies how technological breakthroughs affect humans, culture, and the environment. Engineering, Applied Science, Industrial Arts, and Basic Science are among its sources. Engineering applies theoretical fields like physics and chemistry to real-world challenges. Mathematical concepts and relationships are studied using specialized notation in algebra, geometry, and calculus.

Despite the fact that these are the commonly recognized and/or descriptive names for STEM fields, they unquestionably encompass a great deal more. Since the general public has a solid understanding of these disciplines, STEM education places them front and center. Particularly, K–12 schools lack the resources necessary to educate students engaged in technology and engineering (Miaoulis, 2011).

The author emphasizes the importance of reversing the fall of American scientists, engineers, and mathematicians in rising the energizing and employing America for a brighter future (Lantz, 2009). In 2006, Congress ordered a report with four suggestions for prioritizing science and technology investments to meet future needs and create high-quality jobs. Math and scientific education in the US should be funded more to boost the talent pool. STEM education and workforce training grew due to declining academic STEM performance and worldwide competition concerns (Wang et al., 2011).

According to Dugger (2010), the STEM education movement began in specialized charter or magnet schools that excluded traditional public-school pupils from their programs in the United States. In 2008, only 37,000 students were enrolled in STEM focused schools (National Research Council of The United States, 2007). According to the National Science Board (2012), the majority of STEM graduates have not yet secured employment in their respective disciplines. Communities and institutions collaborate infrequently (National Research Council, 2007), which is surprising given the significance of attracting young people to STEM careers. According to Bursal and Paznokas (2006), districts frequently lack the time and resources essential for teacher education due to financial constraints and mandatory projects.

During the period of the NCLB (No Child Left Behind) program, the quality of scientific instruction declined (Bybee, 2010). According to Dorph et al. (2011), the increasing ELA (Emphasis on English Language Arts) and Mathematics has resulted in a significant transition away from and deemphasis on the teaching of scientific concepts in schools, particularly at the elementary level. According to Jorgenson and Vanosdall (2002), "teachers and school administrators across the United States are facing enormous pressure to improve test scores in the basic skills areas." As a direct result of this pressure,

"they have been forced to reduce or, in some cases, eliminate the amount of time devoted to science in the classroom."

The National Science Board (2012) reports that a considerably smaller proportion of students in the United States pursue careers in STEM. According to Blotnicky et al. (2018), the scientific and mathematical components of STEM curricula, which are typically taught separately, are often not effectively integrated into the technology and engineering of the curricula. Because science and math are typically taught separately, this is a common problem. According to Blotnicky et al. (2018), a completely developed STEM curriculum may provide students with the opportunity to pursue scientific careers, which is crucial for meeting the future demand for scientists and engineers.

Students in STEM fields have the opportunity to cultivate skills relevant to the 21st century, which may be essential to their long-term success as professionals and citizens. According to Bybee (2010), an increasing number of K–12 educational institutions are recognizing the significance of engineering, which inspires students to innovate and find solutions to issues. According to Bursal and Paznoks (2006), teachers in the classroom require assistance in order to comprehend how to teach because they do not have adequate training in science.

According to Lantz (2009), the lack of a defined definition of STEM was the main barrier to the development of educational initiatives that were focused on STEM. Despite advocating for the adoption of STEM education in American schools, the United States Department of Education (2013) was unable to define what exactly constitutes a STEM curriculum and provided scant guidance on how to strategically approach such integration or evaluate a STEM curriculum's efficacy after adoption (Stansbury, 2011).

### **2.1.2. From STEM to STEAM Education**

It could be challenging to define STEAM education. Although educators are aware of the value of STEM education as a pedagogical necessity to enhance learning (Lansiquot, 2016) and an economic imperative of education (Chesky & Wolfmeyer, 2015), educators and researchers do not agree on the definitions of STEM education (Breiner et al., 2012). Despite the fact that educators recognize the significance of STEM education, this is still the case. There are a limited number of sources for publications that provide comprehensive advice and actionable strategies. In fact, the Department of Education uses the acronym STEM in its strategic initiative to emphasize the best method to develop 21st-century skills (Stehle & Peters-Burton, 2019).

STEAM education is an approach to education that emphasizes the growth of the arts in addition to the development of proficiency in the fundamental areas of STEM. STEAM education evolved from STEM education. This is an essential contrast between STEM education, which teaches applicable material in the disciplines of mathematics, computer science, and science, and education that focuses on the arts. STEAM incorporates not only the visual arts but also the literary arts, the performing arts, and digital design, such as the creation of websites. According to the hypothesis, many STEM endeavors run the risk of falling short of their maximum potential if they lack an element of creative design as well as communication and collaboration (Smyrniou et al., 2020).

The RISD (Rhode Island School of Design) is credited with coining the term "STEAM" and was the driving force behind a countrywide STEM arts initiative. According to the Rhode Island School of Design (RISD), scientists, computer programmers, and authors ought to collaborate and have an understanding of one another. Even before the acronym STEAM had gained widespread recognition, educators were experimenting with different versions of STEM in order to more effectively incorporate

the arts and humanities (Abu Khurma et al., 2022). Yakman (2010) correctly anticipated the aesthetic potential of mathematical and scientific fields, which resulted in the acronym STEAM being coined. Yakman's (2010) goal is to integrate the arts into STEM fields in order to break down the "silos" that exist within those fields.

In the United States, one of the key goals of STEM education is to improve STEM literacy among all children. According to studies, the process of accomplishing this goal begins with early and continuous exposure to subjects that fall under the STEM umbrella. Despite this, there has been very little advancement achieved in the establishment of integrated STEM curricula for pupils in elementary education (Lantz, 2009). Unfortunately, secondary school students are frequently forgotten about when it comes to measures to improve STEM education (DeJarnette, 2012).

It has been established that young children benefit the most from early exposure to such learning activities (Nadelson et al., 2013), and primary school pupils are not too young to participate in and grasp the ideas behind STEM fields. Children's awareness of the physical, biological, and social worlds and how they operate develops well before they join formal education, according to A Framework for K–12 Science Education Practices, which was published in 2012 by the National Research Council. This report was published by the National Research Council. Elementary school students have a ravenous appetite for expanding their intellectual horizons and learning about the world around them. According to Bosse et al. (2009) and the National Research Council (2013), young individuals who possess these characteristics have a greater propensity to pursue careers in the STEM sectors.

According to Smart and Schools (n.d.), effective STEM education builds on students' existing knowledge and skills, focuses on areas of particular interest, and provides them with hands-on opportunities to investigate scientific techniques that pique

their curiosity and maintain their interest. According to Lottero-Perdue et al. (2017), an integrated STEM education that places an emphasis on learning through hands-on experience and inquiry can help children develop greater levels of autonomy and self-management. Dillivan and Dillivan (2014) conducted a STEM camp over the course of three days throughout the summer. They found that inquiry-based activities were the most effective technique to pique children's interest in STEM topics. The enthusiasm of elementary students will result in enhanced mastery of fundamental principles, thereby facilitating their comprehension of more complex STEAM concepts. This is why STEM education in elementary institutions is growing in significance (Epstein & Miller, 2011; National Research Council, 2012).

After-school, vacation, and other enrichment activities have dominated elementary STEAM initiatives. The 2010 Bayer Corporation Compendium of Best Practice in K–12 STEAM Education lists successful efforts. These courses offer advanced engineering and technology training. STEM problem-based projects teach critical thinking and teamwork (Brenner, 2009). Bayer Corporation's (2010) Storybook-based engineering classes help primary kids understand STE(A)M concepts. Young children require a more comprehensive STEM/STEAM education method. Our educational system must "cultivate, excite, and promote their STEM learning in order to influence their future career decisions" (Cotabish et al., 2011) to produce effective STEM innovators and professionals.

Roberts et al. (2018) say STEM education wasn't supposed to be a separate subject with certification requirements. STEM education uses cognitive and constructivist learning theories to create engineering (DOD, 2012; Roberts et al., 2018). STEM courses are integrated, hands-on, inquiry-based, project-based, and transdisciplinary. STEM was more than just an interdisciplinary curriculum that introduced technological standards into

science and math subjects (Shaughnessy, 2013). STEM is unfamiliar to many K–12 educators (Wang, 2012). STEM education leaders must understand interdisciplinarity and teachers' duties (Berlin & White, 2012; Cunningham & Cordeiro, 2003; Dugger, 2010). STEM implementation, instruction, and prerequisites must be considered (Nadelson et al., 2012). Choose the finest STEM teaching and learning method to promote STEM education (Singer, 2011).

Morrison (2006) argues that STEM education is an attempt to create a unified framework for pedagogy that can accommodate the emergence of novel fields of study. When all subjects and STEM classes are combined, the four traditional barriers are removed (Kaufman et al., 2003). According to Morrison (2006), teachers in STEM fields should combine curriculum design and execution, encourage innovation and application, and link classroom activities to real-world challenges. The next generation of STEM educators must understand the interconnectedness of the many STEM fields and the roles they play in teaching (Cunningham & Cordeiro, 2003; Dugger, 2010). Educators can do more to boost STEM education if they can identify the most successful STEM teaching and learning techniques (Singer, 2011). There is a pressing need for new teachers to quickly gain expertise in STEM fields (Berlin & White, 2012; Brown et al., 2011).

Training in STEM subjects is beneficial for teachers as more schools adopt technological solutions. According to a report published by the National Commission on Teaching and America's Future (2011), two-year research funded by the National Science Foundation found that STEM teaching and student achievement improve when instructors collaborate to develop strong professional learning communities in their schools. Students in today's schools are getting themselves ready to create new information, find solutions to problems, and acquire new skills by working together. (Fulton & Britton, 2011) In

order for students to achieve their full potential, educational institutions need to be modeled after the workplaces they will occupy in the future.

Educators are concerned that STEAM education places an excessive amount of emphasis on STEM subjects at the detriment of the arts (Bequette & Bequette, 2012). Some instructors (Sanders, 2009) view STEM as the total integration of literacy, numeracy, and the application of science and mathematics. Other instructors, however, view STEM as a transdisciplinary strategy that emphasizes the incorporation of the arts and humanities into STEM curricula (Morrison, 2006).

Even though there is a wealth of knowledge, no nation has decided on a uniform approach to teaching STEM subjects. The National Science and Technology Council (2013) provides a report on a discussion that is continuing around the knowledge and expertise in STEM subjects that make for the best instructors. Improvements in STEM education are increasingly demanded in the US. According to numerous sources, including Dugger (2010), the National Science and Technology Council (2013), and the U.S. Department of Education (2013), a significant barrier to the establishment of STEM education programs is the absence of a precise definition of STEM.

According to Nadelson et al. (2013), teachers' beliefs about learning and instruction influence instructional practice and decision-making. Teacher effectiveness and quality have the greatest impact on students' education (Bursal & Paznoks, 2006). Therefore, student and teacher attitudes influence STEM achievement and contribute to STEM education expansion issues (Paulson, 2012). A teacher's attitude toward teaching science and math may have an impact on how and how much they do so (Paulson, 2012). According to Bursal and Paznokas (2006), the belief that science and mathematics are challenging and only a select few can master them has an impact on student achievement.

Scientific education and cognitive skills greatly affect economic outcomes. Thus, world leaders who want to build human capital for economic growth have prioritized STEM education. Bangladesh, one of the fastest-growing economies, needs an integrated STEM education approach from elementary to postsecondary (Munir & Shams, n.d.). Scientific education and economic development have been thoroughly studied worldwide. Islam et al. (2014) found that economic growth requires quality-adjusted education. Marginson et al.'s 2013 comparative study found that Asian economies with highly trained STEM workforces do better economically. Thomas and Watters (2015) evaluated the three factors that impact scientific education in Australia, India, and Malaysia using data from these three countries. Educators and students equally hold differing perspectives regarding STEM education.

In early education, where the foundations of science and mathematics are established, Bangladesh's infrastructure for this education is inadequate. The majority of kindergartens are overloaded. The dropout rate in Bangladesh Education Statistics 2018 is 38.30 percent. Rural and isolated areas lack lab facilities, making government measures like making Information and Technology topics obligatory for secondary education questionable (Ministry of Education, 2019). According to Education Watch, 41.3% of classrooms lack multimedia and laboratory apparatus. Two-thirds of the teachers had difficulty utilizing laboratory or multimedia resources (Munir & Shams, n.d.).

According to Harris and de Bruin (2018), the ways in which "creativity" is rooted, politicized, and practiced affect how secondary school teachers approach teaching it. It shows how instructors and students view, act, benefit from, and struggle with the development of critical and creative thinking. Brown et al. (2011) defined STEM education as "a standards-based, meta-discipline residing at the school level in which all teachers, especially STEM teachers, teach an integrated approach to teaching and

learning, where discipline-specific content is not divided but instead addressed and treated as one lively, fluid study." A number of obstacles to STEM education, such as inadequate training and a shortage of qualified STEM teachers, a lack of funding for teachers' professional development, and a lack of cross-disciplinary STEM research, are to blame for students who may become scientists, engineers, and technologists' lack of interest in STEM disciplines. (Ejiwale, 2013).

### **2.1.3. STEAM Education**

The National Research Council (2011) found that STEM programs in schools lacked a consistent and challenging curriculum. Connecting what is learned in the classroom to real-world applications is essential while teaching STEM. Unfortunately, schools tend to compartmentalize the teaching of subjects like English, Math, Science, and Social Studies, leaving little room for the application of instructional technology or engineering principles. Even though most primary schools appear to lend themselves to integrated learning because children are typically with the same instructor, Wang et al. (2011) argue that this is not the case.

The value of STEAM education in fostering the knowledge and abilities required for the modern world is currently being reassessed. According to Ge et al. (2015), global modernism, which mixes science, technology, engineering, art, and mathematics, has contributed to a worldview that promotes STEAM education and the importance of the arts. STEAM and multidisciplinary education are encouraged in many industrialized nations. One option to give kids a thorough, multidisciplinary STEAM education is to use VR to incorporate sustainability concerns into STEAM education (Hsiao & Su, 2021).

An updated curriculum will emphasize adaptability, vitality, and acceptance of all students. "STEAM" is a multidisciplinary collaboration between the humanities and

social sciences and the STEM fields of science, technology, engineering, and mathematics. Colucci-Gray et al. (2017) discuss the promise and challenges of creatively integrating STEAM education into 21st-century learning. STEM and STEAM approaches to the study of science are distinct from one another. Evidently, STEM places an emphasis on developing and promoting ideas through the application of rigorous scientific, technical, engineering, or mathematical skills. The discussion suggests that kids in the STEAM program make use of both logical and creative problem-solving skills. By combining the perspectives and practices of the arts, STEAM enhances students' understanding of STEM subjects. It accomplishes this by employing methods like data visualization and high-quality visuals. STEAM professionals are inspired to use 3D printers to build new products and translate complex data sets into understandable images like infographics because of their ability to think creatively and solve problems (Norman & Zoncita, 2023).

Bertrand (2019) investigates the outcomes of STEM and STEAM education by comparing and contrasting the two. In North America, project-based learning has become an increasingly popular teaching method. Using STEM pedagogical approaches, it is possible to adequately prepare students for the world in which they will live and work. The purpose of this research is to learn more about the STEAM education reform movement in Canada and the STEAM curriculum and educational programs given by Canadian nonprofits and publicly funded institutions of higher education.

Aguilera and Ortiz-Revilla (2021) claim that STEAM is a subcategory of STEM. In order to encourage young people's enthusiasm for science, both strategies employ a multidisciplinary approach that places a strong emphasis on the importance of student's creative abilities. For a thorough grasp of STEAM, it is necessary to have expertise in the

fields of science, technology, engineering, the arts, and mathematics in addition to knowledge in other disciplines.

STEAM has attracted recognition for its efforts to integrate the arts into STEM learning frameworks; however, its application has been criticized by Mejias et al. (2021). Many informal educators, in particular, have embraced it as a warm and sincere method of piqueing students' curiosity in STEM fields. However, as is the case with many emerging disciplines, there is considerable ambiguity and insufficient understanding surrounding the notion and practice of STEAM. They are frequently used in imprecise or potentially problematic ways to achieve a wide range of aims in theory, education, and practice.

In 2020, Jesionkowska et al. mentioned STEAM and augmented reality. The classroom is rapidly changing thanks to immersive technology, augmented reality, and STEAM. Particularly, augmented reality (AR) has shown promise as a resource for STEAM instruction. As a result, only a select few students are able to take advantage of the many augmented reality options available because so few professors are using this new technology. There is no room for testing because the curriculum is already bloated and schools generally only have access to developmental tools. The incredibly small number of helpful instructional apps makes the situation worse.

However, Dorofeeva et al. (2020) stressed the importance of a STEM/STEAM focus while preparing future educators. It promotes transdisciplinary learning, which is thought to be crucial in helping individuals understand the interconnected nature of science. Education that integrates STEM disciplines with the arts (STEAM) has proven to be an effective strategy for this goal. The history and development of STEM and STEAM education, the most recent trends, the roles and responsibilities of students and

teachers, and the internal and external variables that facilitate or impede its incorporation into educational systems in a variety of countries.

Education for Innovation was launched under the Obama administration when STEM programs expanded across the country (Wintrode, 2020). STEAM programs are frequently implemented in middle schools, and liberal arts are incorporated into the curricula of some schools. Middle school STEAM programs are evaluated based on student interest, student efficacy, and teacher confidence.

Anisimova et al.'s study (2020) found that there is a high demand for programmers, systems engineers, IT specialists, biotechnologists, project managers, etc. because of the development of the digital economy and society. The use of cutting-edge pedagogical methods, such as STEAM education, has proven especially useful in this respect. Educational systems have the responsibility of preparing the necessary personnel with the meta-subjects, design, and research abilities necessary to put the STEAM education concept into operation. Another facet of STEAM education is the introduction of the "robotics" subject into the education of future teachers of physics, mathematics, technology, the visual arts, and other disciplines.

McCullough (2022) defines STEAM education as an approach to learning in which students engage in creative problem solving while also acquiring skills in the STEM disciplines through exploration and experimentation. Despite being a priority at the national level, there is much debate over what STEAM education actually is and how it should be implemented in the classroom. It is anticipated that K–12 schools in a number of states will implement curricula that include STEAM disciplines within the next decade. Wang et al. (2022) explored ways to combine STEAM into modern IT because of the dynamic nature of science and technology. This study develops a STEAM-based hybrid learning strategy by fusing traditional classroom instruction with internet resources. It

utilizes a cloud-based platform for teaching that is based on the STEAM educational framework.

Using a STEAM approach in the classroom has been shown to increase students' willingness to learn as well as their capacity for cross-disciplinary analysis and independent problem solving (Yilmaz, 2021). ElSayary (2021) also explores the use of genuine online evaluation in the creation and distribution of STEAM curricula. The study employed the transdisciplinary STEAM curriculum's incorporation of authentic assessment as a conceptual framework, with a particular emphasis on the cognitive, psychomotor, and affective domains of learning. According to his definition, a transdisciplinary education allows students to ignore artificial boundaries between disciplines in order to better address real-world issues.

#### **2.1.4. STEAM Education and Teachers**

Teachers in K–12 classrooms need support since they lack experience in STEM subjects (Berlin & White, 2012). Library of Congress (2008) studies show that hands-on scientific education programs in middle and high schools do not support traditional science education curricula. The National Research Council (2007) found that just 40% of teachers in grades 7–12 have a background in science or mathematics. Elementary school instructors need to have specialized knowledge and abilities to effectively train their students in STEM subjects (Berlin & White, 2012). According to recommendations made by teacher professional bodies, many K–12 science and math teachers have not completed as many courses in their area(s) of specialization as they should have (Honey et al., 2014).

Studies by Cotabish et al. (2011) say that elementary school teachers are where the STEM stream starts. Even though early education sets the stage for later STEM

learning, elementary school teachers are often not ready to teach kids in these areas (California Department of Education, 2012). Science and math lessons can build on what students learned in the first few grades. Cotabish et al.'s (2011) study shows that most elementary school teachers feel unprepared and worried about teaching STEM subjects.

Studies at the elementary, middle, and high school levels (Portz, 2015) show that STEAM programs are not very successful, even though they are getting more money. Teachers often don't give their students an integrated education because they only pay attention to one thing at a time. (Bybee, 2010; Moore & Smith, 2014) For example, teachers often focus on math or physics and pay little attention to engineering and technology. Some of the reasons for this are the difficulty of using new ways of teaching, the narrow focus of many teachers, and the general lack of understanding of what STEAM is.

Caprara et al. (2006) and Stohlmann et al. (2012) say that successful integrated STEAM teaching requires both content knowledge (CK) and pedagogical knowledge (PK). Professional development (PD) in STEAM (Wang et al., 2011) has shown that teachers still have trouble integrating technology and different subjects or disciplines into their lessons, even when they work with peers from different fields. Not everyone agrees on the best way to teach STEAM courses (Herro et al., 2019), which is another thing that keeps them from being widely used.

Research has shown that there are a number of difficulties associated with STEAM programs, such as increased planning time, limited storage space for materials, negative attitudes held by some teachers, the need to learn something new, and ineffective evaluation. It was also difficult for educators to integrate content areas and converge on common standards (Nadelson et al., 2013). Teachers may struggle with STEAM integration, leading to tension between theory and practice. "Design cycles" that

emphasize hands-on activities without a solid scientific and mathematical basis may be oversimplified in the absence of competent STEAM teachers that can embody this concept of integrated STEAM (William, 2011).

### **2.1.5. Teacher with Professional Development**

Hoi (2021) writes that introducing STEAM subjects to primary school students comes with advantages and disadvantages. Advantages include elementary school children's natural curiosity about the world and their eagerness to learn, as well as the chance to provide pupils with a solid foundation in STEAM subjects and the leeway to experiment with new approaches to teaching STEM subjects (Nadelson et al., 2013). Some of the problems with implementing STEM education are a lack of funding, an emphasis on reading and arithmetic, and an unprepared teaching force (Nadelson et al., 2013). Morrison et al. (2009) agree that in order for teachers to take advantage of these possibilities and overcome these threats, they will need consistent chances for professional growth (Adelson et al., 2013). Research into the efficacy of these professional development opportunities in improving teachers' STEM education readiness is required.

Teachers' ability to acquire CK in several STEAM areas has been demonstrated to benefit through the integration of professional development (PD) into numerous curricular programs for in-service teachers (Nagdi et al., 2018). Although these efforts have been made, whether they adequately address the demands of educators who seek to use STEAM curriculum in their classrooms remains unclear. The study by Nagdi et al. (2018) found that teachers need opportunities for cooperation and professional development in order to successfully provide integrated STEM instruction. Nonetheless, research by Honey et al. (2014) demonstrates that partnerships between industry STEM workers and after-school or summer program teachers can benefit both parties.

In-service educators can gain access to professional development (PD) opportunities in a variety of STEAM fields through a variety of curriculum initiatives (Nagdi et al., 2018). It is unclear, however, whether or not these initiatives meet the needs of teachers who wish to include STEAM lessons in their classrooms. According to studies (Nagdi et al., 2018), science, technology, engineering, and mathematics (STEM) educators need chances to collaborate and advance their careers in order to give effective, integrated STEM instruction. However, working together and developing one another's professional abilities can be beneficial for both industry STEM workers and teachers in after-school and summer programs (Honey et al., 2014).

According to Honey et al. (2014), teacher preparation programs across the country are working to provide prospective teachers with the necessary content knowledge (CK) in a variety of STEAM disciplines, and an increasing number of programs are providing STEAM-focused in-service PD. It may go without saying, but it is critical to remember that many of the changes that will most likely be required to successfully adopt integrated STEM education would necessitate an increase in funding. To assist educators in getting information and PCK in disciplinary areas that are not directly related to their prior education or areas of competency, time and careful planning will be required (Honey et al., 2014).

#### **2.1.6. STEAM Education and Students**

The "A" in STEAM, which stands for "Arts," designates that STEAM education is an extension of STEM education that includes a second emphasis on the arts (Anisimova, 2020). It acknowledges the value of combining the creative process with the STEM disciplines of science, technology, engineering, and mathematics. Students from all walks of life and with a variety of interests are invited to take part in STEAM-related instruction. STEAM education can reach a wider spectrum of students who may have

varied learning styles or preferences by embracing the arts, which can offer different pathways for expression and participation. It offers chances for students with various abilities and talents to participate and achieve in the educational process.

Students' learning can be made more relevant and engaging by incorporating the arts into STEM disciplines. By including artistic and creative components, STEAM education engages students' interests and makes challenging ideas more approachable and pleasurable. This approach can help boost the proportion of students majoring in STEM fields by appealing to their artistic aspirations while simultaneously piquing their interest in the hard sciences and technical fields (Rabalais, 2014). A well-rounded education includes both technical skills and creative aptitudes, which STEAM education acknowledges. Students that participate in STEM-related arts programs receive a strong foundation in science and math as well as proficiency in the visual arts, music, robotics, and other creative fields (Sullivan & Bers, 2018). They are prepared for a variety of job pathways thanks to this all-encompassing approach, which also promotes general personal development.

STEAM education encourages students to think creatively, research novel ideas, and approach problems from various angles (Perignat & Katz-Buonincontro, 2019). According to Connor et al. (2015), students are given the chance to exercise their imaginations, experiment with creative ideas, and come up with novel solutions when the arts are incorporated into STEM topics. While working on challenging projects in STEAM education, students are urged to think critically and analytically. They develop their ability to inquire, investigate, and assess data from many sources. Teamwork, communication, and the capacity to function well in varied teams are all promoted by collaborative activities like group projects and practical experiments, and a well-rounded education includes both technical skills and creative aptitudes, which STEAM education

acknowledges (Yamada, 2021). The growing demand for multidisciplinary abilities and creative thinking on the labor market is in line with the needs of STEAM education. Ilori and Ajagunna (2020) stated that students are prepared for careers in architecture, design, multimedia, robotics, and other STEAM industries through STEAM education.

### **2.1.7. Bangladesh Educational System**

During the mid-18th century, the education system in Bengal, which encompasses present-day Bangladesh and the Indian state of West Bengal, underwent substantial transformations under British colonial governance (Mitra, 2001). The British colonial administrators implemented a system of education in Bengal that mirrored Western standards, encompassing disciplines such as English language, mathematics, science, and history (Al-Quaderi & Al Mahmud, 2010). English has been adopted as the primary language of instruction in numerous educational institutions, including schools and colleges. The Madrasa education system for Muslims was also institutionalized during the British era (Zayed, 2016). The alterations made to the education system during the period of British colonial rule exerted a profound and enduring influence on the culture, society, and economy of the region, thereby molding its trajectory even subsequent to the cessation of colonial governance (Bose & Jalal, 2022).

After British rule, the country was divided. After India was partitioned in 1947, East Bengal became East Pakistan, which is now Bangladesh (Ferdous, 2021). East Pakistan was part of Pakistan from 1947 to 1971, and national policies, regional dynamics, and societal demands shaped the education system. East Pakistan's education system struggled with the language (Hossain & Tollefson, 2017). The sole state language of Pakistan, Urdu, produced linguistic and cultural difficulties in East Pakistan, where Bengali was the most commonly spoken language. The 1952 language movement shaped East Pakistani education and identity (Murshid, 2022). The education system of East

Pakistan during that period was characterized by its association with cultural and political issues, particularly linguistic and the struggle for emancipation.

Bangladesh began shaping its educational policies and system after independence from Pakistan in 1971 (Tunali, 2019). Bangladesh's Constitution made education a right and stressed illiteracy elimination. Bangladesh emphasized comprehensive primary education (Mehtab, 2019). Curriculum reform and quality improvement were prioritized in secondary education (Rahman et al., 2010). The 1974 National Education Policy (NEP) guided Bangladeshi education but the National Curriculum and Textbook Board (NCTB) was created to standardize the national curriculum and produce primary and secondary textbooks (Asian Development Bank [ADB]. (2015). Bangladesh recognizes digital learning because of its educational potential. Electronic learning systems, internet materials, and digital classrooms improve education and reach remote students (Chowdhury, 2020). Bangladesh government has taken steps to boost literacy, enhance educational facilities, and provide quality education to all inhabitants.

## **2.2. Theoretical Framework**

STEAM is an educational strategy that has emerged alongside STEM with the goal of reviving young students' scientific literacy. With the inclusion of the arts, student creativity is described as a key skill that requires special attention (Aguilera & Ortiz-Revilla, 2021). STEM education has been widely adopted in K–12 and higher education settings and has become an integral part of the American educational landscape (Reimann, 2020). STEAM education is a newer concept than STEM education, which refers to the traditional academic disciplines of science, technology, engineering, and mathematics. The history of STEM education begins in the 1960s and '50s (Bybee, 2013). In order to assist America's technical and economic development, STEM education aims to develop a workforce with the necessary skills (Kelley & Knowles, 2016). The new pedagogy

called STEAM has been applied to STEM education, which has the irony of being purely scientific and technical (Sithole et al., 2017). STEAM has evolved for the 21st century and has gained popularity as a teaching strategy in educational settings, including schools and other organizations (Ridwan et al., 2017).

According to Wintrode (2020), Integrated STEM programs have exploded in United States schools since the launch of the Obama administration's Educate to Innovate program in 2009. These initiatives encourage inquiry-based, technology-driven learning through cooperative, cross-curricular projects. They are intended to enhance the number of STEM professionals in the workforce and support the United States' continued viability in the global economy. Middle schools are a common location for STEM and STEAM programs, acting as the "pipeline" for the K–12 STEM and STEAM curriculum. In this case, The STEAM program was evaluated through interviews with the middle school's principal, faculty, teachers, students, and classrooms. A middle school supporting the STEAM project has a strong leader and committed faculty. Students are interested in STEAM careers and education, according to the student poll and classroom observations, and they are growing more confident about their capacity for problem-solving, communication, and collaboration, as well as responsible technology use. Responses from female and minority students are similar. STEAM learning is an important part of a successful school culture, driven by a strong administrator and dedicated faculty. Data from state tests shows steady improvement in students meeting or exceeding standards (Harris & De Bruin, 2018).

Education is regarded as one of the most crucial drivers of socioeconomic development, along with the realization of human potential, which is a fundamental right for Bangladeshi citizens (Rahman et al., 2018). There are several issues with secondary education in Bangladesh, including low enrollment and retention rates, inadequate

teaching and learning, and a lack of relevance to the demands of the workforce of the 21st century (Alam, 2009). With a more relevant and interesting learning environment that equips students for success in the 21st century, STEAM education has the ability to alleviate some of these issues (Yakman & Lee, 2012). The Primary Education End Examination (PECE) and Junior School Certificate (JSC) were subsequently introduced by the Bangladesh Ministry of Education to solve the myriad issues with Bangladesh's educational system (Hossain & Jahan, 2021). However, the COVID-19 pandemic, which has disrupted education and exacerbated preexisting inequalities in Bangladesh, has made these problems worse. Later, the PECE and JSC exam systems were discontinued, and Bangladesh's educational system went back to the old exam system, where students would take the Secondary School Certificate (SSC) exam at the conclusion of their time in school (Correspondent, 2022).

Even in the aftermath of a pandemic, the main focus of STEAM education is on teaching students the skills they will need to succeed in the 21st-century workforce (Pramesti et al., 2022). By combining the STEAM domains, STEAM education allows students to apply their knowledge and skills across a variety of subjects and recognize the connections between them. In a STEAM education program, lessons are learned through hands-on, project-based activities that encourage students to apply their newly acquired skills to resolve problems in the real world. Bertrand and Namukasa (2022) state that the goal of STEAM education is to teach students how to think like designers, which entails teaching them to be interested, look into alternatives, prototype and iterate, and consider how their solutions will effect people and the environment.

## **CHAPTER III:**

### **RESEARCH METHODOLOGY**

Chapter III provides information about the methodology used in this study which consists of research approach and design, data collection techniques, data analysis, validity and reliability, and research ethics.

#### **3.1. Research Approach and Design**

To provide an understanding of the topic at hand, the qualitative approach with case study design is used. Crowe et al. (2011) said that an in-depth investigation and analysis of a single occurrence of interest are the foundation of a qualitative case study, which is a sort of research that aims to provide insights into that instance. To comprehend the world better, this technique places more emphasis on qualitative data than on quantitative data. According to Creswell and Creswell (2018), qualitative research is a strategy for understanding and appreciating the diverse viewpoints that individuals and groups have on a social or human problem. Since qualitative research makes it easier to gain a thorough knowledge of the perspectives and experiences of research participants, it is particularly well suited for the investigation of complex social phenomena including culture, identity, and human behavior. According to Gay et al. (2012), the tone is also unique and descriptive.

This investigation will be mainly concerned with how STEAM education is implemented in secondary schools. The focus here is on teachers and students' views and understandings about their assessment of STEAM education in Bangladesh. A qualitative case study gives the study a clear pathway to engage with the participants, who are the main recipients of the STEAM education program in Bangladeshi schools. As for the case, a public and a private secondary school located in Bogura, Bangladesh, were selected for

this case study of the implementation of STEAM education. The schools are selected because they offer STEAM education and use English as the medium of instruction.

### **3.2. Methods of Data Collection**

The data collection techniques used in this study are observation, interviewing, and focus group discussion.

#### **3.2.1. Observation**

One of the most crucial steps in qualitative research is simply observing the phenomena under study. As indicated in the aforementioned sentence, this method entails "systematically and meaningfully collecting data using one's senses, especially sight and hearing" (McKechnie, 2008). According to Adler and Adler (1994), observations are the "fundamental foundation of all research methods" in the field of social and behavioral sciences. The educational landscape, in particular, might be difficult to accurately observe. McKechnie's (2008) observational approach was used for this investigation. The researcher took notes and listened attentively while student teachers participated in STEAM classes. All of the observing was done from the sidelines in a classroom setting. The researcher's method of observation did not entail any communication or engagement with members of the general population outside of selected STEAM education school.

#### **3.2.2. Interview**

The current study uses semi-structured interviews (see Appendix for the interview) with district education officer and two school principals in Bogura, Bangladesh. Due to the semi-structured interview's adaptable framework, the researcher is able to prompt or encourage the interviewee if they express interest in what they are saying or ask for further information (Rowley, 2012). Using this technique, the researcher

can press the interviewee for more details or explore a different path of research motivated by what the subject says.

### 3.2.3. Focus group Discussion

To better understand the phenomenon of STEAM education, the current study uses focus group discussions (see Appendix for the FGD) with teachers and students in two secondary schools in Bogura, Bangladesh. The students and teachers are interviewed in separate groups. Focus groups are a kind of in-depth questioning that is done in a group. They have a specific plan, size, makeup, and way of asking questions (Mishra, 2016). The main subject of study is group interaction. Participants' reactions to each other's thoughts and contributions affect the discussion. The aim behind using Focus group discussion is to better coordinate the discussion about STEAM in groups of teachers and students. The teachers in the focus groups were two of the three teachers in each group. While the student groups consisted of six students in each group.

Table 3.1  
*Data collection techniques and Participants*

| Data collection method | Respondents   |   |  |                           |
|------------------------|---|---|--|---------------------------|
|                        | School has STEAM curriculum (private) English           | School doesn't have STEAM curriculum (private)- Bangali | School doesn't have STEAM curriculum (public)- Bangali | District Education Office |
| Observation            | 3 classrooms (including teachers & students engagement) | n/a   | n/a  | n/a                       |
| Interview              | n/a   | 1 principal   | 1 principal  | Officer                   |
| FGD                    | n/a   | 3 teachers<br>6 students                                | 3 teachers<br>6 students                               | n/a                       |

### **3.3. Data Analysis**

In terms of data analysis, a systematic approach was employed, involving thematic analysis of the data collected for the study. Thematic analysis is a systematic methodology employed to discern, classify, and offer significant interpretations of data (Braun and Clarke, 2012). The data collected from the study sites will be analyzed using Braun and Clarke's (2012) six-phase thematic analysis framework to generate the final report. Those steps are following:

This initial phase involves the examination and comprehension of the data gathered from the study participants in order to become acquainted with the information. The second stage is generating initial codes and during this stage of the study, the process of assigning initial codes offers a comprehensive understanding of the collected data and aids in the categorization of the responses. The inclusion of this feature facilitated the subsequent identification of themes during the search process. The third stage was searching for themes and this phenomenon occurs subsequent to the assignment or generation of codes. The researcher analyzed the collected data and identify themes based on the assigned categories of codes. Similarly, reviewing potential themes was the next stage which started once the potential themes have been identified by the researcher, a comprehensive review of these themes was conducted in order to consolidate certain themes and, if necessary, revisit the codes to uncover additional themes that contribute to a more comprehensive description of the study. Likewise, defining and naming themes was the next step before the report is finished, the themes' names and meanings are labeled in accordance with the findings. The final report was created at the conclusion and include all pertinent study-related themes.

The researcher used the six processes listed above to examine the data gathered from the study participants in the current investigation. In light of the fact that the data came from many participants with various levels of background. Data familiarization and segmentation into recurrent patterns in the responses of the participants were part of the initial stage. The segmented data were afterwards transformed into themes, which were further examined and added to the final report.

### **3.4. Validity and Reliability**

Data collection, analysis, and research quality depend on validity and reliability (Shank, 2006). Creswell and Miller (2000) defines validity as a qualitative study's accuracy from the researcher, participants, and readers' perspectives. Researcher confidence in study results is validity. According to Yin (2009), the validity of qualitative research depends on its reliability.

#### **3.4.1. Internal Validity**

Data credibility is internal validity in a qualitative study (Shank, 2006). Stake (2010) defined triangulation as corroborating evidence from many sources. According to Patton (2014), triangulation demonstrates that varied data or approaches may result in different findings because they are sensitive to numerous real-world information. Inconsistencies in findings across different types of data can provide insight on the relationship between inquiry approach and the topic under study (Patton, 2014), not undermine results credibility. Open-ended interviews and member verification can be used to triangulate data in a qualitative case study (Bogdan & Biklen, 2007). In this study the internal validity is achieved through triangulation both in data collection methods by having observation, Interviews and FGD and further it is validated through data gathering from different sources such as students, teachers and principals.

Using multiple data sources, triangulation is a common method for analyzing results. Cohen and Manion (2000) defined triangulation as a multifaceted approach to understanding human behavior. Stake (2010) described triangulation as gathering evidence from multiple people, types of data, or data collection methods for corroboration. According to Patton (2014), triangulation demonstrates that different types of data or techniques may produce various outcomes because they are sensitive to real-world variations. A qualitative case study can include member checking, participant responses, and interview questions to triangulate data (Bogdan & Biklen, 2007). Triangulation, using several sources, and member checking to reduce bias and boost data reliability (Bogdan & Biklen, 2007). Contrary to popular opinion, conflicting results across multiple sources of data might help researchers understand the relationship between the inquiry approach and the topic being examined (Patton, 2014).

This study will use a variety of data sources, such as focus groups, interviews, and observation, to achieve triangulation. With the district education officer, two secondary school principals from public and private institutions were subjected to a semi-structured interview. Additionally, conversations in focus groups with instructors and students from the same school are held. Additionally, a private English-medium school was seen implementing STEAM instruction.

### **3.4.2. Reliability**

Huck (2012) defines reliability as "the consistency of the results for a variable within an assessment or other form of the research instrument." Inside a relatively short amount of time, the data for this STEAM education implementation were gleaned from observations, interviews, and discussions held inside focus groups. According to Bogdan and Biklen (2007), conducting interviews, checking in with other members of the group,

and using triangulation are all effective ways to lower the possibility of bias and raise the dependability of the data. According to Merriam (2002), reliability is defined as the capability of other researchers to replicate the findings of an investigation by employing the same research methodology.

In this study, reliability is ensured by being thorough, careful, and honest in conducting the research. The data for STEAM education implementation were collected through observations, interviews, and focus group discussions within a relatively short timeframe. To minimize bias and enhance data dependability, I followed effective practices, such as conducting interviews, seeking input from group members, and using triangulation, as recommended by Bogdan and Biklen (2007). Moreover, my research methodology is structured to maintain consistency during data collection, allowing other researchers to replicate the study and verify the findings, in line with Merriam's definition of reliability (2002).

### **3.5. Research Ethics**

Research ethics ensure scientific impartiality, human rights, and social cohesion. ensuring safe, informed consent to research. Wellington (2000) defines ethical consideration as group or profession-specific morality for leading. understanding ethical considerations for researchers and study. Education researchers are accountable to participants, beneficiaries, the field of knowledge, and colleagues (Govil, 2013). According to Gajjar (2013), ethical considerations improve the study's goals, prevent fabrication and advance the truth, foster accountability, mutual trust, and respect, gain public support for the study, and strengthen moral and societal values. This study acknowledges that research ethics are crucial to study integrity, trustworthiness, and dependability. The following are some of the most important factors that should be taken into consideration:

Informed Consent: The researcher provided an explanation of the potential repercussions that could result from the research participants' participation. According to Israel and Hay (2006), the researcher shared information with the participants regarding the prospective outcomes of the study, as well as its goals, benefits, needs, dangers, challenges, and discomforts. In addition, the researcher made sure that the participants had the chance to actively participate in information exchange.

Confidentiality and Anonymity: The researcher took measures to safeguard the confidentiality of participants' information and maintain the anonymity of their responses (Israel & Hay, 2006). The confidentiality of the participants was safeguarded by implementing anonymization techniques, as ensured by the researcher.

## **CHAPTER IV:**

### **FINDINGS AND DISCUSSION**

A thorough analysis of the research findings is provided in the findings section, which offers a context-specific explanation of the relevance and significance of the findings in Bangladeshi secondary schools. Observations were the first step in the study of STEAM education. This was followed by individual interviews with principals and the district education officer, as well as focus group discussions with students as well as teachers. The discussion section examines the elements that lead to implementation as well as the advantages and disadvantages of STEAM programs that have been put into practice. It also discusses potential difficulties and roadblocks. It also discusses how STEAM education affects students' drive, imagination, critical thinking, and goals for their future careers.

#### **4.1 Findings**

The goal of the STEAM education school observation is to understand the engagement between teachers and students, how STEAM methods are applied in practice and to gain insight into teaching methods with learning experiences. It enables researcher to explore the impact of STEAM education on STEAM curriculum implementation, use of resources and technology, student motivation and engagement, and student learning outcomes. As a researcher, I spend time in classrooms observing teachers' delivery of STEAM classes, what kinds of projects or practical activities students complete, how technology is incorporated into the teaching and learning process, and the level of student participation. By comparing the observations and the findings, it is possible to identify the findings of the first research question in 4.1.1, the findings of the second RQ in 4.1.2, and the findings of the third research question in 4.1.3.

#### **4.1.1. Current State of STEAM Education Implementation in Bangladeshi Secondary Schools (RQ.1)**

##### ***4.1.1.1. District Education Officer's Perspective***

The district education officer thinks STEAM education will benefit students' academic and eventual employment success. The goal of STEAM education is to provide students with the transdisciplinary knowledge and skills they need to succeed in the workforce of the twenty-first century by combining science, technology, engineering, the arts, and mathematics into a single educational experience.

Since Bangladesh's National Curricular Framework 2021 adopted an assessment-based education system for secondary school grades 6 and 7, many curricular changes have occurred. Books are now taught differently. STEAM education will change textbooks for a practical education system. Seminars and training programs will be held to give instructors the skills and knowledge they need to teach STEAM courses, as the National Curriculum Framework 2021 requires (NCTB, 2023). According to the district education officer,

"For the implementation of STEAM education and the education ministry's guidelines, teachers will be trained according to their subject and teaching methodology; also, as STEAM is a practical-based education system, lab classes will be implemented" (District Education Officer).

STEAM Education training aims to help teachers implement cutting-edge teaching techniques and integrate practical activities into their classes. In order to achieve the goal of government strategic plan named Digital Bangladesh, IT labs have been set up in schools, and schools will also be modernized for each level of STEAM education as a practical-based in the STEAM education system. For instance, making sure that schools have explore to relevant educational software, simulations, and online resources to improve the learning experience; making sure that there are quality labs to support practical experiments and project-based learning; setting up labs to encourage students to

participate in a variety of creative projects, etc. The implementation of STEAM education should also be continually improved by using data and input from teachers and students, and schools should be observed to explore its effectiveness.

#### ***4.1.1.2. Principals' Perspectives***

According to the public secondary school principal, a new education policy has been proposed based on the National Curricular Framework 2021 (NCTB, 2023), even though Bangladesh does not currently have a STEAM education policy. As opposed to this, the test-based education system has begun in junior secondary school grades 6 and 7 and will be in place from pre-primary through grade 12 at once.

“But in today's digital world, where technology is altering industry and society, a crucial STEAM education will do just that, preparing our students to embrace the opportunities and challenges that lie ahead” (Principal).

STEAM education is an innovative and comprehensive approach of education. It integrates multiple disciplines into an interdisciplinary framework that fosters critical thinking, problem-solving, collaboration, and creativity. This education will equip students with the necessary skills and knowledge to thrive in a rapidly changing world.

Students will receive practical knowledge in junior secondary school through STEAM education as they experiment and discover the wonders of the natural world through science. The STEAM curriculum also includes engineering, which encourages students to think creatively and solve issues. It will teach students how to use creativity with math and science to address problems in the real world. However, the arts foster creativity and infuse beauty and passion into the fields of science and technology. Students can grasp complicated issues clearly and precisely through the use of mathematics in STEAM education. If STEAM education is adopted, there will be teacher

training and laboratories at each level of STEAM education, which is now being done in accordance with the National Curricular Framework 2021 (NCTB, 2023).

According to the private secondary school principal, private secondary schools are more prevalent in Bangladesh because private schools frequently place a greater emphasis on better facilities, resources, and technological integration. The National Curricular Framework 2021 aspires to develop assessment-based education in grades 6 and 7 in secondary schools, even though STEAM education, or practice-based education, is not fashionable. Some of the private English-medium schools in Bangladesh's main cities offer pupils specialized courses in areas like coding, programming, or engineering to fulfill the demands of the modern day. These schools are lab-based and cater to students who want to address the difficulties of the modern age.

Element such as curricular requirements, exams, and expectations that place a stronger emphasis on academic courses may also have an impact on the adoption of STEAM education in Bangladeshi secondary schools. Even though the curriculum includes all the STEAM courses, engineering is not one of them. In order for subject instructors to enthusiastically participate in courses if STEAM is introduced, the government will also need to administer the training program. Additionally, the private secondary school's principal stated,

“Online education system started for the first time during the corona pandemic, initially all students attended regular classes, but some students got involved in social media and group games and they fell behind in learning” (Principal).

The deployment of STEAM education systems should be continuously monitored in terms of technology utilization in order to retain students' enthusiasm for studying. Technology in STEAM education can increase student engagement and learning, but it must be used with caution to reduce distractions. The principal can support students in

their studies and make the most of STEAM education by using engaging digital tools, implementing a blended learning approach, developing quality content, actively monitoring student activity, designing insightful assessments, and encouraging responsible use of technology.

This focus group discussion's objective is to look at the benefits, drawbacks, and opportunities related to STEAM education. Helping children develop abilities like critical thinking, teamwork, and problem-solving is a major focus of the STEAM curriculum. Both the teachers and the students can add insightful group discussions to the study project. This is so that the instructional approach can be improved and molded according to the perspectives of the teachers and pupils. An open and cooperative discourse reveals creative suggestions, doable strategies, and potential areas for development in the implementation of STEAM education in secondary schools.

#### **4.1.2. Challenges and Opportunities Associated with Implementing STEAM Education (RQ.2)**

##### ***4.1.2.1. Challenges for Teachers***

Teachers in both public and private schools may find it difficult to modify current curricula to include STEAM subjects, according to secondary school teachers. To make sure that the STEAM method is in line with the recommended curriculum, that exam criteria are met, and that key knowledge and skills are covered across a variety of topics, careful planning and curriculum development activities are necessary. According to a teacher,

"Since this curriculum emphasizes practical learning, we need training, and the students will need appropriate lab classes for quality practical classes where we will teach them" (teacher).

In order to give students the knowledge and skills they need, teachers too need training. Teachers might not have the pedagogical expertise and abilities needed to successfully incorporate these issues into their teaching methods. For effective integration of STEAM education into teaching practices, teachers in both professions require specific training and professional development programs. Building teachers' knowledge, abilities, and self-assurance in delivering STEAM classes requires continual training due to the multidisciplinary character of STEAM disciplines and the demand for novel pedagogical techniques.

Education in the STEAM fields is very different from conventional educational approaches. Teachers in both public and private schools will have a difficult time coming up with the right assessment methods and tools to gauge students' creativity, problem-solving abilities, critical thinking abilities, and interdisciplinary learning outcomes. In Bangladesh, there may be resource limitations for both public and private schools. Another teacher said,

"No distinction can be made between government and private schools; equipment should be provided in lab classes according to the number of students" (teacher).

Limited funding, a lack of infrastructure, and an inadequate supply of laboratory equipment, technology tools, and teaching materials can all hinder the execution of hands-on STEAM activities and practical learning experiences. Even if the government is providing the technology and lab equipment, it is still necessary to periodically examine them. The demands of the teachers at both institutions are frequently excessive, leaving them little time for lesson planning and instructional preparation. Designing interdisciplinary lessons, working with other teachers, and leading practical activities are all steps in the integration of STEAM learning that take more time and effort.

Last but not least, for STEAM education to be successfully implemented in secondary schools, both public and private instructors require assistance, direction, and opportunities for collaboration. To overcome these obstacles and facilitate the successful implementation of STEAM education in both public and private secondary schools in Bangladesh, adequate investment in resources, curriculum reforms, teacher training programs, assessment reforms, and creating a supportive educational ecosystem are necessary.

Based on the researcher's observation, Teachers have faced many challenges in implementing and teaching STEAM education in schools, as they have been trained and built practical classrooms to implement STEAM education in schools. For example, limited budgets or inadequate infrastructure to explore the materials and technical devices needed for effective STEAM learning were barriers to implementing lab activities, experiments, and projects. Teaching and integrating multiple disciplines in STEAM education were challenging for teachers. To overcome these challenges, teachers are also trained to effectively integrate STEAM education into their teaching practices, which helps them develop pedagogical strategies, incorporate project-based learning, and keep pace with advances in STEAM education. On the other hand, traditional assessment methods, such as written tests, cannot effectively capture the various skills and competencies developed through STEAM learning. Another difficult task for teachers was to develop appropriate and effective assessment strategies that matched the practical and innovative character of STEAM.

#### ***4.1.2.2. Opportunities for Teachers***

Despite these challenges, teachers have the opportunity to discover how technology tools and resources can improve student engagement and learning. Teachers

with strong backgrounds in the visual arts can incorporate artistic aspects into courses, inspiring students' self-expression and creativity. The first opportunity in STEAM education, according to secondary school teachers in both public and private secondary schools, is practical education. Students can apply theoretical information to real-world circumstances thanks to STEAM education's emphasis on experiential, practical learning. Speaking about the opportunity, a teacher said,

"In order to give students knowledge about the real world, we must first gain knowledge about the real world, and as teachers it is our responsibility and duty to keep ourselves in constant study" (teacher).

Experiments, group projects, and other group activities are some of the ways in which teachers provide students the opportunity to enhance their practical skills and get new insights into how concepts and theories can be applied to situations that occur in the real world. Teachers do this so that students can become more well-rounded. Additionally, STEAM education uses an interdisciplinary approach that unites several fields of study and encourages all-around learning. Teachers have the chance to create lessons and exercises that help students develop a deeper comprehension of linkages to the real world and foster critical thinking, problem-solving, and creativity.

Collaboration, teamwork, and efficient communication are encouraged by STEAM education. A teacher said about teamwork,

"Students will no longer be busy with individual learning, students will learn and understand from school life how to coordinate with their classmates, which will be beneficial in their future or career" (teacher).

To help students collaborate and acquire the skills necessary for teamwork in the workplace, teachers support group projects and problem-solving activities. When given the opportunity to work in groups, students will be more innovative and creative in their work since STEAM education encourages them to explore, experiment, and think critically. In order to encourage students to come up with novel answers to global

problems, we will cultivate an environment that encourages curiosity, taking risks, and open inquiry. Bangladesh is technologically far ahead of other countries; as a result, STEAM will combine technology and education to help pupils gain technological literacy and expertise. Through IT teachers, kids will learn how to use digital technologies to prepare for the digital age and use them in their future employment in STEAM-related fields.

By producing a workforce with the ability to flourish in the contemporary economy, a focus on STEAM education would increase Bangladesh's competitiveness on the global stage. Teachers can encourage students to pursue higher education and professions in STEAM-related fields by helping Bangladesh develop its technology and creativity. whereby students will strengthen their critical thinking, problem-solving, and adaptability skills in order to provide themselves with the information and abilities required for a variety of occupations in science, technology, engineering, the arts, and mathematics. In addition, sharing best practices and successfully implementing STEAM education would help students in Bangladesh achieve their full potential. Collaboration between public and private secondary schools will help this happen.

In terms of opportunities, the researcher also observed that the STEAM education teachers are expected to teach is fraught with difficulties, but there is no shortage of potential. Therefore, despite the difficulties that may arise, instructors are given the training they need to successfully incorporate STEAM learning into their classroom activities. Learning in the STEAM disciplines gives educators the opportunity to take an active role in the education of their pupils. Teachers have the ability to increase student involvement and interest in STEAM classes by incorporating hands-on activities, applications that are relevant to the real world, and problem solving. Teachers have the

power to create cooperative learning settings in the classroom, in which students work together in groups to improve their ability to communicate, interact, and work effectively in a group setting.

Through STEAM learning, teachers support their students' creativity and innovation. To encourage students' critical thinking and creativity, teachers can experiment with different teaching methods, project-based learning strategies, and open-ended challenges. By encouraging student innovation through STEAM learning, teachers can relate classroom learning to real-world situations. To show how STEAM concepts can be applied in practice, teachers can use examples and industry collaborations. It improves students' understanding and motivation. Last but not least, teachers complement STEAM learning with technological tools. Teachers at this school embrace coding, so using technologies like simulations, modeling tools, coding platforms, and online resources, they provide dynamic learning opportunities for students and introduce them to cutting-edge innovations.

#### ***4.1.2.3. Challenges for Students***

Students' unexpected inability to comprehend the new curriculum presents a difficult STEAM education challenge for secondary school students in private as well as public schools. Students have not studied English in their primary schooling lives as they abruptly enter secondary school, which is why they are having numerous issues with English courses in the National Curricular Framework 2021 for grades 6 and 7. According to students who have just passed grade 5 and progressed to grade 6,

"We are very weak in English; the English we learned in primary education is different when we come to secondary education. Which is difficult for many students" (student).

Despite the fact that many students struggle with English language proficiency, dialogue writing is part of the curriculum. Similarly, if language is employed in STEAM education, it needs to be taught effectively. Practical education is not widely available in Bangladesh's public or private schools, and only Grade 8 science graduates have explore to practical lessons. Additionally lacking in instructional resources and technical equipment is the IT lab. Bangladeshi students are used to traditional teaching strategies that prioritize memory. Some students may find it difficult to change their learning mindsets while using interactive and inquiry-based learning techniques in STEAM education.

In Bangladesh, social mores and cultural preconceptions extend beyond the study of science. The arts of singing, acting, dancing, and debate are also well-suited to some students. According to the students who want to dance, sing, and give speeches,

"We are somewhat aware of the two educational principles in STEM, or STEAM, but we agree on the way to implement STEAM. Because we students who are addicted to dancing, singing, or art can do it in detail" (student).

This focus may lead to a bias in favor of STEM disciplines within the STEAM framework, potentially devaluing the arts and deterring students from pursuing their creative potential. Standardized examinations and other conventional methods of evaluation fall short of accurately capturing the abilities and learning outcomes acquired through STEAM learning. Within the confines of conventional evaluation frameworks, students may find it difficult to demonstrate their creativity, problem-solving prowess, and critical thinking talents. The diverse employment prospects in STEAM-related professions, which are not taught at all in school life, are not sufficiently explained to pupils, and thus they lack suitable career assistance. By doing so, students will be able to comprehend how STEAM education is used in real-world situations and what career pathways might be available to them.

The study's observations also indicated that students face a number of problems. Understanding and combining concepts from a variety of fields presented a significant obstacle for students participating in STEAM-based educational programs. It can be challenging to navigate the complexities of inter-disciplinary learning and to apply information in ways that cut across academic boundaries. Because mastering STEM subjects requires students to engage in critical thinking and information analysis in order to participate in activities that involve problem-solving, In the beginning, these talents were challenging to develop for some of the kids. On the other hand, a few of the students admitted that working in groups can be difficult, but they all agreed that studying STEAM was vital to the development of strong communication and collaboration abilities. Education in the STEAM disciplines promotes student autonomy and an inquiry-based approach to learning. There are certain students who may have difficulty managing their own learning by establishing goals and adopting initiatives that call for support from the teacher.

#### ***4.1.2.4. Opportunities for Students***

After conquering the obstacles, the possibilities that the students will be given will be crucial in helping them confront the challenges of the twenty-first century. We students participate in experiments, projects, and activities right from school because STEAM education places a strong emphasis on practical learning and practical experience. A student claim that,

“By applying theoretical knowledge to practical tasks, we students gain a deeper comprehension of ideas and problem-solving skills in different topic areas are linked via STEAM education” (student).

To help them build a comprehensive awareness of the world and how many fields intersect, students have the chance to discover how several disciplines are interconnected.

Students are encouraged to think creatively, investigate novel concepts, and invent through STEAM education since they will have the chance to learn how several fields are interconnected. Students can express their creativity through projects like designing, building, or artistic expression. These projects encourage experimentation, curiosity, and thinking beyond the box.

Students have the opportunity to cultivate an entrepreneurial attitude that will benefit our future ventures. Students can explore prospective occupations that match their interests and strengths by gaining knowledge, skills, and real-world experience in STEAM disciplines. Technology-based tools are used in STEAM education to improve the educational process by allowing students to investigate, model experiments, and acquire technical abilities that are ever more crucial in the current world. Collaborative projects and group work that simulate real-world scenarios are frequent components of STEAM education. It promotes personal development and lifelong learning. In light of this, students can cultivate a growth mindset and set themselves up for lifelong self-improvement and adaptation in a world that is changing quickly. Students' ability to compete globally can be increased by participating in STEAM education. It values those who possess strong analytical, technical, and creative skills that are compatible with the requirements of the contemporary employment market.

Ultimately, the introduction of STEAM education will give students in Bangladesh's secondary public and private schools the chance to acquire a variety of skills that will motivate youngsters like us to be prepared for success in the 21st century global environment. Despite these challenges, STEAM education allows students to participate in experiments, projects, and activities, encouraging critical thinking, problem solving, teamwork, and creativity, as the researcher observed. Students are exposed to the outside

world through practical classes, experiments, and projects. Students are motivated to think creatively and innovatively as a result of their education. It gives students the opportunity to come up with their own ideas, consider many options, and work on open-ended problems. STEAM learning improves students' ability to think critically, take risks, and develop original ideas. As part of this education, students are often required to work in teams and complete group projects. Students gain the ability to communicate effectively with peers, share their ideas, and work toward a common goal. It helps develop interpersonal skills important for academic success, such as collaboration, leadership, and clear communication.

Students have the opportunity to strengthen their digital technological skills through STEAM education. They are using various Steam-related technological devices, programs, and technologies while coding. As a result, students now have the skills needed for today's world. Students who receive STEAM education develop a love of learning and a respect for lifelong learning. Although STEAM education is in all departments of the school curriculum, engineering is new, and because of this, engineering students are learning engineering measurement, robotics, and drawing through AutoCAD. Students who take a STEAM education are better prepared for careers in science, technology, engineering, the arts, and mathematics. It helps students discover their interests and passions through a variety of STEAM-related occupations and careers.

#### **4.1.3. Attitudes and Perception towards STEAM education (RQ.3)**

##### ***4.1.3.1. Teachers' Attitudes and Perceptions***

Teachers claim that while STEAM education shares math, science, technology, and the arts with the middle school curriculum, engineering does not. since the material here differs from what is covered in the textbook. To keep up with changes in scientific

knowledge, teachers may need continual professional development. However, technical or ICT education is a big part of what all schools are doing. Teachers can discover how technology tools and resources can improve student engagement and learning. Artistic aspects can be incorporated into courses by teachers who have strong backgrounds in the visual arts. The classroom can benefit from the arts' ability to inspire students' self-expression and creativity.

A crucial component of education is the teaching of mathematics, and many educators are skilled and knowledgeable in this field. They might feel at ease instructing students on mathematical ideas, problem-solving strategies, and logical thinking abilities. However, a teacher claims that teachers will come up with inventive strategies to deal with arithmetic fear or to interest students who have difficulty with the topic. As was indicated at the opening, teaching engineering principles would be foreign to many teachers, especially those without an engineering background, as engineering is not a separate subject within the curriculum. To effectively teach engineering concepts, design thinking, and problem-solving techniques, they could feel that they need more help and training. Whether the teacher works in public or private secondary schools, the resources that are available, the support from the administration, and the collaboration with colleagues will all have a huge impact on how comfortable and enthusiastic teachers are about teaching and learning each component of STEAM education.

The study also observed that teachers who encourage a supportive environment should make the classroom a safe place for students to express themselves without inhibition. Across all types of instruction, teachers provide opportunities for group projects and cooperative learning. Students are motivated to participate in debates, exchange ideas, and thereby take different perspectives into account. Students can then

express their curiosity and feel safe to think creatively. Additionally, teachers in subject-based classes engage in open-ended inquiry, which encourages students to engage in deeper inquiry-based learning. By harnessing students' skills and ingenuity to tackle challenges, collaborative activities also encourage innovation.

Within the STEAM field, teachers instruct students using a variety of perspectives, theories, and instructional strategies that help develop a more comprehensive understanding of the material and strengthen students' critical thinking abilities. Students who receive a STEAM education develop a growth mindset, which holds that knowledge and abilities must be acquired through effort and repetition. This is because through this type of learning, students embrace curiosity and take intellectual risks to enhance their creativity and critical thinking abilities. Students eagerly anticipate novel insights, perspectives, and ideas. Students also apply creative thinking and problem-solving techniques to their own projects.

#### ***4.1.3.2. Students' Attitudes and Perceptions***

Students assert that because STEAM education prioritizes theoretical and practical education, we can effectively grasp all facets of this educational policy. Science is an intriguing topic to study since we students are inherently curious about the world around us. Through this education, we can take part in practical experiments, inquiry-based learning, and scientific concept exploration. Because we live with technology every day, we can employ the most up-to-date tools to make learning more enjoyable. For students in secondary schools like, engineering will be an engaging and useful part of STEAM education. Problem-solving, critical thinking, and project design will all be opportunities provided through practical learning. Although mastering engineering ideas to address

problems in the real world is difficult, we students will approach it with a constructive outlook.

Students' reactions to art-related materials will vary. Artistic pursuits, including debate, music, theater, and drama, may appeal to students who have a natural interest in the arts. This education allows us to better prepare for a variety of competitive activities. There will be wide disparities in how students feel about arithmetic. Mathematical riddles and equations will be pleasant to solve, and students will like the logical and problem-solving parts of the subject. Students' interest and motivation will rise if there are interesting and useful applications of mathematics in the curriculum.

#### ***4.1.3.3. Students' Learning and Practical Experience***

STEAM education encourages active learning strategies that let students do experiments, pursue inquiry-based learning, and investigate scientific ideas. With this strategy, students' understanding is enhanced, and learning is more fun. The students claim that,

“If their educational system is practical-focused, then they will be able to understand the theory and even the written material in their textbooks” (student).

The learning process is improved, and students may keep current by incorporating technology into STEAM instruction. Students have the chance to practice project design, critical thinking, and problem solving when engineering is integrated into STEAM instruction. Despite these difficulties, students approach engineering subjects from a positive angle, which improves their hands-on learning.

#### ***4.1.3.4 Students' Entrepreneurial Mindset***

Students who participate in STEAM-related activities are more likely to develop an entrepreneurial spirit because they are taught to think creatively and find solutions to

issues. Students are given the opportunity to improve their preparation for a variety of competitive activities thanks to this education. The incorporation of the arts into STEAM education inspires students to express themselves creatively and in their own unique ways, both of which contribute to the development of an entrepreneurial attitude. Students have the chance to cultivate their uniqueness and freely express themselves through the medium of the arts, which is one of the learning modalities available to them. Students have the opportunity to study their particular interests, passions, and personal narratives when they participate in artistic activities such as visual arts, music, dance, or theater. This form of self-expression helps create originality as well as confidence and the bravery to try new things, which are all benefits of developing one's own unique voice. Students are encouraged to completely accept who they are and to seek out methods to turn their personal experiences into ideas for businesses they could start.

Students develop an entrepreneurial attitude by engaging in artistic exploration and expression as part of their classroom experience. Students who have this mentality are distinguished by their insatiable curiosity, inventiveness, flexibility, and passion to make a difference in the world. Students are inspired to question the status quo, to challenge assumptions, and to create new ways of doing things when they participate in the arts. According to a female student,

"Many individuals look down on those of us who continue to study in the humanities after the eighth grade; yet, if STEAM education is implemented, it will be advantageous for us. Because we include the arts in our school curriculum, we have the ability to mold the future" (student).

STEAM integrates art into education, developing students' creative and entrepreneurial potential. They develop the skills and perspectives needed to navigate the ever-changing landscape of entrepreneurship, where creativity, innovation, self-expression, and interdisciplinary thinking are key drivers of success.

#### ***4.1.3.5. Students' Global Competitiveness***

STEAM education prepares students for global competitiveness by equipping them with the skills and knowledge necessary for the 21st-century workforce. Students are able to develop abilities such as critical thinking, problem-solving, teamwork, and creativity through the multidisciplinary approach of STEAM education. These are all talents that are highly appreciated in today's global job market. According to students who always involve themselves with technology,

“We can learn about engineering and technology in detail after grade 12 if we study engineering and technology by STEAM education, we will get practical knowledge about engineering and technology right from school life” (student).

Furthermore, STEAM education encourages self-directed learning and an inquiry-based approach, which are essential for lifelong learning and adaptability in a rapidly changing world.

## **4.2. Discussion**

In this section, the researcher will provide a comprehensive discussion of the findings derived from the collected data pertaining to the research questions. Specifically, sections 4.2.1 and 4.2.2 will focus on first research question. Sections 4.2.3 and 4.2.4 will delve into the second research question. Lastly, section 4.3.4 will center around the third research question. The discussion will offer valuable insights into the benefits and implications of implementing STEAM education in Bangladesh's secondary schools.

### **4.2.1. Curriculum Development**

STEAM (Science, Technology, Engineering, Arts, and Mathematics) curriculum creation extends beyond the simple combination of the courses STEAM is made of. The objective is to establish an interdisciplinary framework that encourages a comprehensive knowledge of contemporary issues (Bassachs et al., 2020). The curriculum is created to

prepare students for the challenges of the workforce of the twenty-first century (Singh, 2021).

A comprehensive STEAM program must identify relevant learning objectives, include concepts from other disciplines, and link them to academic standards. Students can explore concepts, practice, and solve real-world problems. Determine the required knowledge, skills, and abilities that students will learn through STEAM education and the targeted learning goals for each topic. These include critical thinking, problem-solving, creativity, teamwork, communication, and information application. It is crucial to work together with topic instructors to design cross-curricular modules or projects. Identify the connections between the content and skills of each course that can enhance the learning process as a whole. Seek out opportunities to reinforce ideas across disciplines and to inspire students to draw connections between them.

Project-based learning, assessment, practical learning opportunities, and technological instruction will all be part of the curriculum. These aspects can be taken into consideration while building a robust and engaging STEAM curriculum for secondary schools that promotes interdisciplinary learning, critical thinking, creativity, and problem-solving abilities in students.

#### **4.2.2. Training and Development for Teachers**

The successful implementation of an interdisciplinary curriculum depends heavily on the training and development of teachers for STEAM education. Teachers must be knowledgeable in their subject areas of expertise and the pedagogical strategies supporting integrated learning (Pant et al., 2020). Workshops on collaborative teaching techniques and education using modern technology that can improve education delivery are frequently included in professional development programs (Boice et al.,

2021). With the scientific and technological advancement of STEAM education, teachers are also encouraged to participate in continuous learning. The study also found that teachers development and on-time trainings prior to the implementation of STEAM is an essential area of consideration.

In order to integrate STEAM education in secondary schools, it is imperative that teachers receive training and growth. The facilitation of STEAM learning experiences and the integration of multidisciplinary approaches in classrooms will heavily depend on teachers. Professional development programs centered on certain pedagogical techniques for STEAM instruction will be made available through the training. Training will provide teachers with a strong foundation in the STEAM subjects they will be teaching. Knowledge of science, technology, engineering, the arts, and mathematics in depth is beneficial to teachers' professional development. Working with subject-matter experts, attending workshops, online classes, or seminars are some possible options.

Given the significance of engineering and technology in STEAM education, instructors must be trained in the proper use of technological tools and resources. There will be workshops or training sessions that assist STEAM learning using software, hardware, coding platforms, robotics, or digital simulations. The development of teachers' abilities to foster student collaboration and teamwork should be the main focus of training. Additionally, it aids educators in creating alternate assessment plans that support STEAM learning objectives. Give instruction on how to evaluate student learning through performance-based tests, portfolios, presentations, and demonstrations. It creates professional learning networks where educators can interact, exchange knowledge, and benefit from one another. These networks of STEAM educators might be found outside of schools or within them.

Secondary schools can provide teachers with the information, abilities, and tools necessary to successfully adopt STEAM instruction by offering substantial training and development opportunities. The successful integration of interdisciplinary techniques is facilitated by teacher empowerment through professional development, which also encourages innovation and improves students' STEAM learning experiences.

#### **4.2.3. STEAM Labs in the Classroom**

The incorporation of lab instruction as an essential component of STEAM education in secondary schools is currently in the process of being implemented. These educational establishments provide their students with opportunities for experiential learning, which develops a wide range of critical thinking abilities. These skills include inquiry, problem-solving, and the application of knowledge in situations that are representative of the outside world. Develop experiments and projects for the classroom that meet the requirements of the STEAM curriculum. Conceive of projects that incorporate ideas from a variety of disciplines, keeping in mind the interdisciplinary character of the STEAM subjects. Experimentation, technical solutions, prototyping, the production of visual works of art, and even coding chores could all fall under this category. In addition, check to see that the laboratory is outfitted with the instruments, resources, and apparatus that are necessary to support STEAM activities. This may involve having explore to the appropriate software or hardware, measuring instruments, safety gear, arts and crafts materials, as well as objects from technology or science.

To evaluate student learning in lab classes, use appropriate assessment procedures. Observations, lab reports, project presentations, or peer evaluations are a few examples of formative and summative assessments to take into consideration. In order to build a comprehensive STEAM-oriented educational environment, major changes in terms of

open e-learning and educational resources both for students and teachers needs to meet (Soroko et al., 2020). To direct students' learning and promote growth, provide them with timely, positive feedback. Middle schools can develop engaging learning environments where students can investigate, test, and apply STEAM ideas in real-world settings by including these factors in their lab sessions. Students' abilities to solve problems, think critically, and connect with STEAM as a whole are all improved by lab experiences.

#### **4.2.4. Students' STEAM Education**

The implementation of STEAM education in Bangladesh's secondary schools can enhance students' educational opportunities in a number of ways, according to the pupils. Education in the STEAM fields promotes participation and active learning. Students may understand the significance of what they are learning and how it pertains to the world around them when real-world situations and practical activities are incorporated into the curriculum. This enhances the educational process and motivates students. The chance to explore various fields and draw connections between various subjects will be provided for students. By encouraging students to think critically and creatively across disciplines, this interdisciplinary approach aids in their conceptual growth. In addition, students encounter difficult problems that call for analytical thinking, the creation of novel solutions, and peer collaboration. Their capacity to approach issues from various angles and come up with answers grows as a result, preparing them for the real world and their future employment. Students learn to express themselves clearly, listen attentively, and work together to attain a goal.

#### **4.2.5. Views and Opinions of Teachers and Students**

STEAM education, which includes math, science, technology, and the arts, is a crucial component of the secondary school curriculum. However, engineering is not

covered in the textbook, and teachers may need continual professional development to keep up with changes in scientific knowledge. Technical or ICT education is a big part of all schools, and teachers can incorporate technology tools and resources to improve student engagement and learning. A study conducted by Park et al., (2016) found teachers positive view regarding STEAM education, but the teachers were constrained given the workload, and technological expertise required to effectively run STEAM education. The classroom can benefit from the arts' ability to inspire students' self-expression and creativity. While Teaching engineering principles may be foreign to many teachers, especially those without an engineering background as this study found.

The resources, support, and collaboration with colleagues significantly impact the comfort and enthusiasm of teachers in teaching and learning each component of STEAM education. Teachers should create a supportive environment by providing opportunities for group projects, cooperative learning, and open-ended inquiry-based learning. STEAM education develops a growth mindset by embracing curiosity and intellectual risks to enhance creativity and critical thinking abilities.

STEAM education emphasizes both theoretical and practical learning, giving students the opportunity to investigate a wide range of facets of educational administration. Activities connected to science, engineering, and art are attractive options for students who have a natural curiosity about the world that surrounds them. Students have the opportunity to engage in activities such as problem-solving, critical thinking, and the design of projects when they participate in practical learning. However, because math has relevant and practical applications across the curriculum, students may find it interesting and motivating. Students who receive schooling that places a strong emphasis on STEAM education have a more nuanced grasp of their interests and areas of strength.

Giving students the chance to learn practically helps them better understand engineering concepts and fosters an entrepreneurial spirit. Participating in STEAM classes that use technology allows students to develop their project design, critical thinking, and problem-solving skills. Students' hands-on learning is improved by using this method, and they are more equipped to compete in a variety of activities. Students' ability to acquire an entrepreneurial mindset is aided by this educational approach. Participating in artistic pursuits such as art, music, dance, or theater can help to foster creativity or self-expression as well as interdisciplinary thinking. Betrand & Namukasa (2020) found that perservance, adaptability and transferable skills are three areas students benefited and considered crucial for their wholistic development with the help of STEAM education.

Students will be equipped for global competition by learning the abilities necessary for work in the 21st century by putting this strategy into practice. Skills like critical thinking, problem-solving, teamwork, and creativity, which are highly prized in the contemporary global job market, are developed by students who take part in STEAM-related activities. Additionally, learning focused on STEAM disciplines promotes independent and inquiry-based learning. Students' capacity for lifelong learning and adaptation to a changing environment is strengthened.

The ingenuity and creativity of STEAM education depends on design and art. They are encouraged to investigate, think creatively, and find answers to issues. When students engage in STEAM learning, they can study more independently. Students that study STEAM courses can develop their skills. Students' feelings will mature and they will have more time to study if they are given the freedom to choose their own projects and academic subject.

## **CHAPTER V:**

### **CONCLUSION AND RECOMMENDATIONS**

The paper discusses the relevance and value of STEAM education in Bangladeshi secondary schools after implementation with a purpose of looking into the state of STEAM education implementation in Bangladeshi secondary schools at the moment together with challenges and opportunities associated with implementation of STEAM education, and the attitudes and perceptions of teachers and students towards implementation of STEAM education in Bangladesh.. It connects the findings to existing research and examines its implementation elements, pros, cons, and potential issues. Observations, interviews, and focus group discussions were conducted to better understand teacher-student dynamics through STEAM and effective teaching approaches. STEAM education affects curriculum creation, resource use, student motivation and engagement, and educational outcomes. Bangladeshi secondary school students, teachers, and principals are debating STEM education. The district's education officer believes a curriculum that incorporates science, technology, engineering, the arts, and mathematics will improve kids' academic performance and job prospects.

#### **5.1. Conclusion**

As a revolutionary strategy to get pupils ready for a dynamic future, the adoption of STEAM education in secondary schools in Bangladesh shows tremendous promise. As findings of this research, it is evident that STEAM education fosters students' creativity, critical thinking, and problem-solving abilities while also providing many advantages that go beyond the boundaries of traditional subject silos. The study's conclusions demonstrate how STEAM education may effectively engage pupils and improve their general learning experience. However, in Bangladesh, secondary school principals, teachers, and students

are not well-informed about or knowledgeable about STEAM education. Moreover, a lot of participants have little of the idea and advantages. Furthermore, there is a lack of the necessary infrastructure, like the computers, contemporary technological tools, and science labs that are equipped with all the necessary equipment for STEAM teaching. There is little place for practical experimentation and application-based learning in the secondary school curricula and evaluation practices now in use. As a result, the technical expertise and training required for Bangladeshi instructors working in the applied education system to apply STEAM education are lacking.

Students are encouraged to collaborate with one another in groups, share their ideas, and draw on the many abilities and points of view of their fellow classmates. These collaborations are a reflection of the realities of the modern workplace, which requires individuals with varying experiences and perspectives to work together in order to solve difficult problems.

By placing a big focus on using knowledge and coming up with original solutions, it encourages an entrepreneurial mentality. This encourages students to take advantage of opportunities, take calculated risks, and work toward their goals. Since it empowers the youth to create jobs rather than just hunt for them, this approach is crucial for Bangladesh's economic development.

To successfully integrate STEAM education in Bangladesh's secondary schools, however, will require the joint efforts of many stakeholders. Infrastructure development, enough funding, and teacher preparation are all necessary to ensure high-quality STEAM education. Partnerships between the government, academia, business, and civil society organizations can also make it simpler to share resources, expertise, and best practices, providing a favorable atmosphere for STEAM education.

STEAM education provides opportunities for professional development. It allows teachers to diversify their knowledge and experience in many sectors, which enhances their capacity to adapt in the classroom. By combining project-based and hands-on learning strategies, teachers may create a lively and engaging learning environment. Thanks to STEAM education, which encourages cooperation and teamwork among students, teachers can exchange resources, ideas, and teaching strategies to collectively improve their instructional methods.

In conclusion, the implementation of STEAM education in Bangladesh's secondary schools has the potential to alter the educational landscape, give pupils the necessary skills, and advance the socioeconomic growth of the country. By raising an innovative, analytical, and technologically knowledgeable generation, Bangladesh can set the standard for innovation globally and ensure the prosperity of its citizens.

## **5.2 Recommendations**

The following are recommendations from this study to the Bangladeshi Ministry of Education, particularly to the program of STEAM education:

1. The STEAM education system in Bangladesh needs to be revised to better cater to the needs of every student, not just talented ones.
2. The STEAM education needs to give more and more practical education in other areas than science.
3. The STEAM education teaching methodology needs a change to emphasize more group and team work rather than individual work or activities.

## **5.3 Limitation and Further Study**

### **5.3.1 Limitation**

The current study aimed to explore the benefits of implementing STEAM education in Bangladesh's secondary schools through a comprehensive approach, including observations in two schools, focus group discussions (FGDs) with teachers and students, and interviews with district school officers and principals. While the study offers valuable insights into the perceptions and experiences of stakeholders regarding STEAM education, it is essential to acknowledge several limitations that may impact the interpretation and generalizability of the findings.

Firstly, the study's limited scope, focusing on only two schools, may restrict the extent to which the findings can be extrapolated to represent the entire population of secondary schools in Bangladesh. The specific contexts and characteristics of the selected schools might not fully capture the diverse realities and challenges faced by schools across the country, leading to potential selection bias and reduced generalizability.

Secondly, data collection through FGDs and interviews introduces the possibility of response bias. Participants' responses might be influenced by social desirability, their perception of what the researchers are seeking, or their awareness of the benefits associated with STEAM education. Additionally, some participants may feel reluctant to express negative opinions or experiences, leading to an incomplete picture of the challenges or limitations of implementing STEAM education.

Furthermore, the study's reliance on qualitative data may offer rich insights into the perceptions and experiences of stakeholders but may lack the statistical rigor and objectivity of quantitative data. The absence of quantitative metrics and standardized

assessments may hinder the ability to measure the extent of improvement in critical thinking, problem-solving, and other skills associated with STEAM education.

Ethical considerations also warrant attention, particularly regarding data privacy and confidentiality. Ensuring the anonymity of participants and securing their consent for participation and data usage might pose challenges, especially when reporting specific quotes or viewpoints in the study.

Lastly, the research team's potential biases and preconceptions about the benefits of STEAM education could influence the study's design, data collection, analysis, and interpretation. These biases might inadvertently shape the presentation of findings, potentially overlooking certain aspects or challenges related to STEAM education. While the current study provides valuable insights into the benefits of STEAM education in two selected secondary schools in Bangladesh, it is crucial to acknowledge the limitations that could impact the generalizability and robustness of the findings. To build on this study's foundation, future research should consider a more extensive and diverse sample of schools, incorporate quantitative measures, address ethical concerns, and adopt a balanced approach that examines both advantages and challenges associated with implementing STEAM education in secondary schools.

### **5.3.2 Further Study**

**Long-Term Impact:** Conducting longitudinal studies to assess the long-term impact of STEAM education on students' academic performance, career choices, and professional success would be valuable. Researchers can better assess the efficacy of this strategy by monitoring the progress of students who have received STEAM education throughout their educational careers and into the workforce.

Gender equality and inclusivity: More research is required to determine how STEAM education may effectively eliminate the gender gap in STEAM disciplines and foster inclusiveness. It would be crucial to comprehend the unique difficulties female students encounter when studying STEAM studies and to find effective ways to promote their involvement.

Comparative Studies: Research comparing schools that have completely integrated STEAM education with those that haven't could shed light on the advantages and difficulties of doing so. These studies can point forth excellent practices, prospective areas for improvement, and potential obstacles to implementation.

Stakeholder Engagement: Investigating the viewpoints of various stakeholders, such as students, parents, instructors, and employers, would offer a thorough understanding of the effects of STEAM education on numerous facets of society. Feedback from these stakeholders can help shape future policy choices and assist STEAM education be customized to fit the needs of all parties involved.

Role of Industry: It would be useful to look into how businesses and educational institutions may work together to promote STEAM education. Fostering a trained and adaptable workforce would benefit from understanding how industries may support STEAM initiatives, offer chances for real-world application of knowledge, and help shape the curriculum.

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## APPENDIX

### Appendix 1: Data Collection

#### Category 1 – Sample Interview: District Education officer and Principals

Semi-structured Interviews for Assessing the Current State of STEAM Education in Bangladeshi Secondary Schools. This involve conducting interviews with district education officer and secondary school principals. Questions include:

1. Can you describe how STEAM education is implemented in your school?

=বাংলাদেশের স্কুলে এখনো স্টিম শিক্ষা কার্যক্রম শুরু হয়নি। তবে গ্রেড ৬ ও ৭ এ নতুন শিক্ষাক্রমের পরীক্ষামূলকভাবে শুরু হয়েছে।

= STEAM education programs have not yet started in schools in Bangladesh. However, the new curriculum has been piloted in grades 6 and 7.

2. What is the current curriculum for STEAM subjects at the secondary school level?

= স্টিম শিক্ষা স্কুলে না থাকলেও মূল্যায়ন-ভিত্তিক শিক্ষা নীতি শিক্ষার্থীদের ব্যক্তিগতকৃত শেখার অন্তর্দৃষ্টির মাধ্যমে ক্ষমতায়ন করে, পাশাপাশি পরীক্ষার জন্য একটি ভারসাম্যপূর্ণ পদ্ধতির মধ্যে জবাবদিহিতা এবং বৃদ্ধির মানসিকতা বৃদ্ধি করে।

= While STEAM education is not in school, assessment-based learning principles empower students through insights into personalized learning, which fosters accountability and a growth mindset.

3. How are teachers trained to teach STEAM subjects?

= যদি এ শিক্ষানীতি বাস্তবায়ন হয় তবে শিক্ষকদের প্রশিক্ষণের বন্দবস্ত করা হবে যা বাংলাদেশের শিক্ষা মন্ত্রণালয় কর্তৃক প্রদায়িত হবে, যেখানে শিক্ষকরা প্রশিক্ষিত হবে স্টিম শিক্ষার নতুন কারিকুলাম ও শিক্ষানীতির উপড়ে ভিত্তি করে।

= If this education policy is implemented, teacher training will be arranged, which will be provided by the Bangladesh Ministry of Education, where teachers will be trained based on the new curriculum and education policy of STEAM education.

4. What resources do you have available for STEAM education, including textbooks, lab equipment, and technology tools?

= যেহেতু স্কুলে প্রযুক্তিভিত্তিক শিখা ব্যবস্থার প্রচলন রয়েছে সেহেতু স্টিম শিক্ষাভিত্তিক পাঠ্যপুস্তক ও ল্যাব সরঞ্জামেরও বন্দোবস্ত করা হবে সরকারিভাবে। কেননা, ব্যবহারিক হাতে-কলমে শেখার জন্য ল্যাব সরঞ্জাম অপরিহার্য।

= As technology based learning system is prevalent in schools, STEAM education based textbooks and lab equipment will also be arranged by the government. Because, lab equipment is essential for practical hands-on learning.

5. How do teachers integrate STEAM into their lessons?

= প্রশিক্ষণের পর শিক্ষকরা তাদের পাঠে স্টিমকে একীভূত করে আন্তঃবিষয়ক প্রকল্পগুলি ডিজাইন করবে যা শিক্ষার্থীদের বিজ্ঞান, প্রযুক্তি, প্রকৌশল, কলা এবং গণিত ব্যবহার করে বাস্তব-বিশ্বের সমস্যাগুলি সমাধান করতে উত্সাহিত

করেবে। উপরোক্ত, সৃজনশীলতা এবং সমালোচনামূলক চিন্তাভাবনার মাধ্যমে শিক্ষকরা ব্যবহারিক অ্যাক্টিভিটি, গ্রুপ কোলাবরেশন, এবং টেকনোলজি টুলস ব্যবহার করে স্টিম ধারণার ব্যবহারিক প্রয়োগে শিক্ষার্থীদের নিযুক্ত করবে।

= After the training, teachers will integrate STEAM into their lessons to design interdisciplinary projects that encourage students to solve real-world problems using science, technology, engineering, art and math. Additionally, teachers will engage students in the practical application of STEAM concepts through hands-on activities, group collaboration, and technology tools through creativity and critical thinking.

6. How do schools measure the effectiveness of their STEAM education programs?

= স্কুলে স্টিম শিক্ষা কার্যক্রমের কার্যকারিতা পরিমাপ করাহবে শিক্ষার্থীদের কর্মক্ষমতা মূল্যায়ন, প্রকল্পের ফলাফল ট্র্যাকিং এবং ব্যস্ততার মাত্রা বিশ্লেষণের মাধ্যমে। শিক্ষকরা শিক্ষার্থীদের সমস্যা সমাধানের দক্ষতা এবং স্টিম শিক্ষার ক্ষেত্রগুলিতে আগ্রহের উপর মূল্যায়ন করবে।

= The effectiveness of STEAM education programs in schools will be measured by exploring student performance, tracking project outcomes and analyzing engagement levels. Teachers will assess students on problem solving skills and interest in STEAM learning areas.

## **Category 2 – Sample FGD: Teachers and Students**

Focus Groups discussion for Identifying Challenges and Opportunities in Implementing STEAM Education, and Attitudes and Perceptions of Teachers and

Students towards STEAM Education. This involve convening focus groups with secondary school teachers and students. Questions include:

1. What challenges have you faced or anticipate facing in implementing STEAM education in your school?

= শিক্ষকদের ক্ষেত্রে "সীমিত সংস্থান, সময়ের সীমাবদ্ধতা এবং ক্রস-ডিসিপ্লিনারি সহযোগিতার প্রয়োজনের কারণে স্টিমকে একীভূত করার ক্ষেত্রে চ্যালেঞ্জের স্বীকার হবে"। বিভিন্ন শিক্ষার শৈলী এবং বিভিন্ন ছাত্রের পটভূমির সাথে সারিবদ্ধ করার জন্য শিক্ষণ পদ্ধতি এবং মূল্যায়নকে অভিযোজিত করাও প্রত্যাশিত বাধা হতে পারে। শিক্ষার্থীদের মতে "আমরা হাতে-কলমে শেখার সাথে খাপ খাইয়ে নেওয়া এবং আন্তঃবিভাগীয় প্রকল্পগুলিতে কার্যকরভাবে সহযোগিতা করার সাথে সম্পর্কিত STEAM শিক্ষায় চ্যালেঞ্জের মুখোমুখি হবো"। উপরন্তু, শিক্ষার্থীরা ঐতিহ্যগতভাবে প্রযুক্তিগত বিষয়গুলিতে শৈল্পিক এবং সৃজনশীল উপাদানগুলির একীকরণের সাথে লড়াই করতে পারে।

= For teachers, "the challenges of integrating STEAM will be acknowledged due to limited resources, time constraints and the need for cross-disciplinary collaboration". Adapting teaching methods and assessment to align with different learning styles and different student backgrounds can also be expected obstacles. According to the students "we will face challenges in STEAM education related to adapting to hands-on learning and collaborating effectively on interdisciplinary projects". Additionally, students may struggle

with the integration of artistic and creative elements into the English curriculum and traditionally technical subjects.

2. Can you describe any resources or support that would be helpful for enhancing STEAM education in your school?

= শিক্ষণ কৌশল, প্রযুক্তি সরঞ্জামগুলিতে অ্যাক্সেস এবং প্রকল্প-ভিত্তিক পাঠ পরিকল্পনার ভান্ডারের উপর দৃষ্টি নিবদ্ধ করে ব্যাপক পেশাদার বিকাশের সুযোগগুলি শিক্ষকদের জন্য স্টিম শিক্ষাকে ব্যাপকভাবে উন্নত করবে।

বিষয়ভিত্তিক ইন্টারেক্টিভ অ্যাক্সেস, সুসজ্জিত ল্যাব, এবং স্টিম ক্ষেত্রের পেশাদারদের কাছ থেকে মেন্টরশিপ স্টিম শিক্ষায় শিক্ষার্থীদের ব্যস্ততা এবং শেখার জন্য অমূল্য সম্পদ হবে।

= Comprehensive professional development opportunities focused on teaching strategies, access to technology tools, and a wealth of project-based lesson plans will greatly enhance STEAM education for teachers. Interactive access to topics, well-equipped labs, and mentorship from professionals in the STEAM field will be invaluable resources for student engagement and learning in STEAM education.

3. Are there any specific policies or initiatives supporting STEAM education at the secondary school level?

= মূল্যায়ন-ভিত্তিক শিক্ষা নীতির পরীক্ষামূলক বাস্তবায়ন করা হয়েছে যা শিক্ষার্থীদের ব্যক্তিগতকৃত শেখার অন্তর্দৃষ্টির মাধ্যমে ক্ষমতায়ন করে, পাশাপাশি পরীক্ষার জন্য একটি ভারসাম্যপূর্ণ পদ্ধতির মধ্যে জবাবদিহিতা এবং বৃদ্ধির মানসিকতা বৃদ্ধি করে।

= Implementation of assessment-based learning principles that empower students with personalized learning insights, while fostering accountability and a growth mindset within a balanced approach to testing.

4. How do you feel about teaching/learning each component of STEAM? Can you describe your experiences?

= শিক্ষকদের মতে STEAM-এর প্রতিটি উপাদান শেখানো এবং শেখা একটি সমৃদ্ধ অভিজ্ঞতা হতে পারে, কারণ এটি আন্তঃসংযুক্ত বিষয়গুলির একটি সামগ্রিক বোঝাপড়া, শিক্ষার্থীদের মধ্যে সৃজনশীলতা, সমস্যা সমাধান এবং বহু-বিষয়ক চিন্তাভাবনাকে লালন করে। উপরন্তুভাবে, শিক্ষার্থীদের মতে এটি একটি সু-বৃত্তাকার শিক্ষার ভিত্তি স্থাপন করে যা আধুনিক বিশ্বের জন্য আমাদের বিভিন্ন দক্ষতার সাথে সজ্জিত করে।

= According to teachers, teaching and learning each component of STEAM can be a rich experience, as it fosters a holistic understanding of interconnected subjects, creativity, problem solving and multidisciplinary thinking in students. Additionally, according to students it lays the foundation for a well-rounded education that equips us with various skills for the modern world.

5. How valuable do you believe STEAM education is for students' futures? Why?

= স্টিম শিক্ষা শিক্ষার্থীদের ভবিষ্যতের জন্য অত্যন্ত মূল্যবান হবে, কারণ এটি শিক্ষার্থীদের একটি বহুমুখী দক্ষতার সেট দিয়ে সজ্জিত করে যা সমালোচনামূলক চিন্তাভাবনা, প্রযুক্তিগত দক্ষতা এবং সৃজনশীল উদ্ভাবনের

সমন্বয় করে। এই আন্তঃবিভাগীয় পদ্ধতি শিক্ষার্থীদের জটিল বাস্তব-বিশ্বের চ্যালেঞ্জ মোকাবেলা করতে, বিকশিত শিল্পের সাথে খাপ খাইয়ে নিতে এবং দ্রুত পরিবর্তনশীল বৈশ্বিক ল্যান্ডস্কেপে অর্থপূর্ণভাবে অবদান রাখতে প্রস্তুত করে।

= STEAM education will be highly valuable for students' future, as it equips students with a versatile skill set that combines critical thinking, technical skills and creative innovation. This interdisciplinary approach prepares students to tackle complex real-world challenges, adapt to evolving industries, and contribute meaningfully to a rapidly changing global landscape.

6. What challenges do you perceive in teaching or learning STEAM subjects?

= শিক্ষকদের দ্বারা স্টিম শিক্ষা শেখানোর ক্ষেত্রে একটি চ্যালেঞ্জ হল কার্যকরভাবে বিভিন্ন শৃঙ্খলাকে একীভূত করা এবং সেইসঙ্গে পৃথক ছাত্রদের চাহিদা এবং পূর্বের জ্ঞানের বিভিন্ন স্তরের সমাধান করা। অন্যদিকে, শিক্ষার্থীদের দ্বারা স্টিম শিক্ষা শেখার একটি চ্যালেঞ্জ হল প্রযুক্তিগত ধারণা এবং সৃজনশীল প্রয়োগের মধ্যে জটিল ভারসাম্য নেভিগেট করা, প্রায়শই বিশ্লেষণাত্মক চিন্তাভাবনা এবং কল্পনাপ্রসূত সমস্যা সমাধানের মিশ্রণ প্রয়োজন।

= A challenge faced by educators in teaching STEAM education is to effectively integrate different disciplines as well as address the needs of individual students and different levels of prior knowledge. On the other hand, a challenge for students learning STEAM is navigating the complex

balance between technical concepts and creative application, often requiring a mix of analytical thinking and imaginative problem solving.

7. How do schools explore and evaluate students in STEAM subjects? Are there any standardized tests or exams that specifically focus on STEAM subjects?

= শিক্ষকদের মতে স্কুলগুলি প্রকল্প-ভিত্তিক মূল্যায়ন, হাতে-কলমে পরীক্ষা, উপস্থাপনা, এবং সহযোগী প্রকল্পগুলির সময়ের মাধ্যমে স্টিম শিক্ষার বিষয়গুলিতে শিক্ষার্থীদের অন্বেষণ করেছে ও মূল্যায়ন করেছে যা তাদের আন্তঃবিষয়ক ধারণাগুলিকে বোঝায়।

= According to teachers, schools will explore and assess students in STEAM learning topics through a combination of project-based assessments, hands-on tests, presentations, and collaborative projects that convey their interdisciplinary concepts.

8. How do teachers and students collaborate effectively in STEAM education?

= শিক্ষকদের মতে শিক্ষক এবং শিক্ষার্থীরা ধারণা বিনিময়ের জন্য একটি উন্মুক্ত পরিবেশ তৈরি করেছে, হাতে-কলমে পরীক্ষা-নিরীক্ষাকে উৎসাহিত করে, এবং একটি সহ-সৃজনশীল পদ্ধতি গ্রহণ করে যেখানে শিক্ষকরা শেখার নির্দেশনা দেয় এবং সহজতর করে, ছাত্রদের বিষয়গুলির মধ্যে অন্বেষণ এবং উদ্ভাবন করার অনুমতি দিয়ে কার্যকরভাবে STEAM শিক্ষায় সহযোগিতা করে। শিক্ষার্থীদের মতে শিক্ষক এবং শিক্ষার্থীরা ছাত্র-চালিত প্রকল্প, সহকর্মী সহযোগিতা, এবং হাতে-কলমে অন্বেষণের মাধ্যমে, স্বাধীন শিক্ষা এবং সৃজনশীলতাকে উৎসাহিত করার মাধ্যমে STEAM শিক্ষায় কার্যকরভাবে সহযোগিতা করে।

= Teachers and students will create an open environment for the exchange of ideas, encourage hands-on experimentation, and adopt a co-creative approach where teachers guide and facilitate learning, allowing students to explore and innovate within topics effectively. STEAM supports education. According to students, teachers and students collaborate effectively in STEAM education through student-driven projects, peer collaboration, and hands-on exploration, encouraging independent learning and creativity.

9. What teaching strategies have you found effective in promoting student engagement in STEAM education?

= প্রকল্প-ভিত্তিক শিক্ষা, হাতে-কলমে পরীক্ষা-নিরীক্ষা এবং প্রযুক্তি-সমৃদ্ধ ক্রিয়াকলাপগুলিকে একীভূত করা STEAM শিক্ষায় ছাত্রদের সম্পৃক্ততা, সক্রিয় অংশগ্রহণ এবং গভীর বোঝাপড়াকে উৎসাহিত করার জন্য কার্যকরী হবে।

= Integrating project-based learning, hands-on experiments, and technology-enriched activities will be effective in fostering student engagement, active participation, and deeper understanding in STEAM education.

10. How do teachers and students incorporate real-world applications and problem-solving skills in STEAM education?

= শিক্ষকদের মতে শিক্ষকরা বাস্তব-বিশ্বের অ্যাপ্লিকেশন এবং সমস্যা সমাধানের দক্ষতাগুলিকে STEAM শিক্ষায় অন্তর্ভুক্ত করে এমন প্রকল্পগুলি ডিজাইন করবে যা বাস্তব পরিস্থিতির অনুকরণ করে, শিক্ষার্থীদের বিশ্লেষণ, উদ্ভাবন এবং সমাধানগুলি বিকাশ করতে উৎসাহিত করবে। তারা বাস্তব-বিশ্বের উদাহরণের মাধ্যমে শিক্ষার্থীদেরকে গাইড করে, তত্ত্বকে প্রয়োগের

সাথে সংযুক্ত করেছে এবং STEAM ধারণার গভীরতর বোঝার উৎসাহ দেবে। শিক্ষার্থীদের মতে, শিক্ষার্থীরা বাস্তব-বিশ্বের অ্যাপ্লিকেশন এবং সমস্যা সমাধানের দক্ষতা স্টিম শিক্ষায় অন্তর্ভুক্ত করে হাতে-কলমে জড়িত প্রকল্পগুলিতে জড়িত যা তাদের বাস্তব জীবনের চ্যালেঞ্জগুলির জন্য গবেষণা, নকশা এবং সমাধানগুলি বাস্তবায়ন করতে হয়। তারা দলে সহযোগিতা করে, ডেটা বিশ্লেষণ করে এবং জটিল সমস্যা মোকাবেলা করার জন্য সমালোচনামূলক চিন্তাভাবনা ব্যবহার করে, ব্যবহারিক অ্যাপ্লিকেশনের সাথে শ্রেণীকক্ষের শিক্ষাকে সেতু করে।

= Teachers will incorporate real-world application and problem-solving skills into STEAM education by designing projects that simulate real-world situations, encouraging students to analyze, innovate, and develop solutions, according to Educators. They will guide students through real-world examples, connect theory with application, and foster a deeper understanding of STEAM concepts. According to students, students incorporate real-world application and problem-solving skills into STEAM education by engaging in hands-on projects that require them to research, design and implement solutions to real-life challenges.

Category 3: Observation Notes:

শিক্ষার পরিবেশ: টিএম স্কুলের ক্ষেত্রে শিক্ষার পরিবেশ এবং  
 শিক্ষার্থীদের জন্য জরুরি বিষয়গুলি  
 রয়েছে, যা টিএম স্কুল, (যেখানে) এবং  
 পরিবেশকে উল্লেখ করে।

প্রশাসনিক প্রক্রিয়া: টিএম শিক্ষা শিক্ষার্থীদের জন্য-কোন  
 কোনো অভিযোগের উপর জোর দেয়।  
 -জিএস, পরিবেশ, কোর্স, ওয়েবসাইট  
 জিএস।

ভাষা: মডার্ন পদ্ধতি: টিএম স্কুলের শিক্ষার্থীরা  
 কয়েক বছর ধরে প্রচলিত  
 শিক্ষার্থীদের পরিবেশের জন্য গণিত  
 দক্ষতা, প্রকৃতির ধর্ম প্রকাশ  
 অন্য বিজ্ঞানের বিষয় এবং  
 বিজ্ঞানের জন্য পদ্ধতি প্রয়োগ  
 হয়।

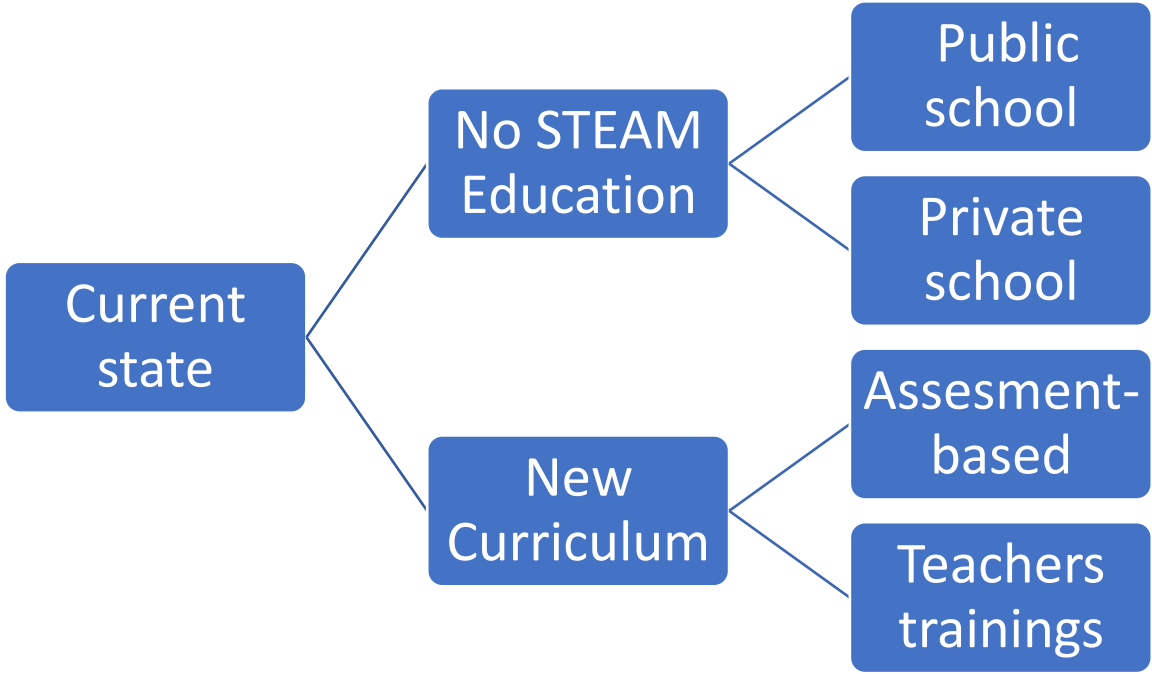
-সমস্যা - সমস্যা এবং সমস্যা সমাধান  
 শিক্ষার্থীরা চ্যালেঞ্জগুলির  
 সমস্যাগুলি-বিদ্যা বিজ্ঞানের  
 উপস্থাপন এবং সঠিক মাধ্যম  
 বিজ্ঞানগুলি পরিবেশ করে।

শিক্ষার্থীর স্বীকৃতি: টিএম স্কুলে  
 স্বীকৃতিতে টিএম-স্কুলের  
 -সুনির্দিষ্ট শিক্ষার্থীর অভিজ্ঞতা  
 শিক্ষার্থীরা তাদের পূর্ণ  
 করে (কিছু) প্রক্রিয়া প্রয়োগ করে।

Appendix 2: Data Coding:

Analysis and

What is the current state of STEAM Education in Bangladeshi Secondary schools?



1. What are the challenges and opportunities associated with implementing STEAM education in Bangladeshi secondary schools from the perspectives of teachers and students?

