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Article

Student's Perception of the STEM Fair at Phnom Penh Teacher Education College (PTEC) During the 2023-2024 Academic Year

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ABSTRACT
Student enrollment in STEM-related disciplines is low across the nation. Students from rural locations with little access to STEM enrichment programs and marginalized demographics should be especially aware of this. This study aimed to investigate how students perceive on STEM Fair and how gender, age, experience, and needs relate to its requirements. The study's population was made up of students from different Phnom Penh schools. There were 242 pupils in the sample. This quantitative study explored students' perceptions of STEM and the effects of the STEM Fair on them. The study employed questionnaires to assess students' interest, knowledge gain, and social self-efficacy. Student participants at the STEM Fair provided survey responses. SPSS 22 was used for data analysis. First, it was discovered that students' perceptions of STEM were characterized by a greater number of constructive and positive comments than unfavorable ones. It is possible that a bigger percentage of positive items in the research sample will signal or guarantee an improvement in participants' impressions of STEM fair. Second, a Chi Square test for independence was used to examine the relationship between the criteria of the STEM Fair and three specific characteristics: gender, age, and experience. The Chi Square results showed that there was insufficient proof to connect the three components to the requirements of the STEM Fair. The information supplied here supports the findings that STEM Fairs increase positive attitudes about STEM and increase STEM knowledge, yet the following useful recommendations are made for future STEM study.

INTRODUCTION

Over the last twenty years, scientists that study science education have looked into why students' interest in the subject decreases from elementary school to high school graduation and then into further education (Bennett et al., 2013; Lykkegaard & Ulriksen, 2019). Reinhold et al. (2018) investigated the causes of the low number of STEM graduates in their systematic study. The researchers made the case that school variables are very important in determining students' interest in STEM subjects and their future goals. They concentrated on how secondary schools affected students' orientation toward STEM careers. Global worry continues to be the falling interest of students in Science, Engineering, Technology, and Mathematics (STEM) programs and associated vocations (Organisation for Economic Cooperation and Development [OECD], 2018). It is estimated that less than 26% of all tertiary education graduates in Europe are STEM graduates. It is believed that this is insufficient to meet the need for scientists and has not altered in the past ten years (OECD, 2019).

In addition, society are dealing with complicated issues including climate change, public health risks, and sustainable living, all of which call for a rise in STEM employment (European Centre for the Development of Vocational Training [ECDVT], 2018). Research in scientific education has evolved from focusing just on cognitive characteristics to also include affective variables associated to science learning in order to examine the reasons why students stray from science. This movement has been made possible by models from the psychology of motivation (Henriksen et al., 2015). The results of these studies show a variety of interrelated factors that affect students' aspirations for careers in science, both intrinsic (i.e., attitude toward science, interest linked to self-efficacy issues, gender, perceived social expectations) and extrinsic (i.e., science capital, socioeconomic status, learning opportunities, school-related factors) (Holmegaard et al., 2014). More precisely, it has been shown that consideration of science curiosity plays a critical role in choosing future scientific fields of study and employment (Potvin & Hasni, 2014).

Additionally, a recent research looking at the variables impacting students' choices of STEM professions discovered that students' desires for STEM careers are hampered by their lack of information about STEM careers (Blotnicky et al., 2018). This is especially true for the STEM fields science, technology, engineering, and mathematics which are widely acknowledged as being key drivers of innovation and economic expansion. However, the number of students seeking STEM degrees has decreased recently, despite the strong demand for STEM professionals and specialists (Baumann et al, 2017; van den Hurk et al., 2019). Concern over the fall in students choosing STEM occupations has grown in the last several years; this trend has been ascribed to many primary causes. One of them is the widespread belief that STEM professions are difficult and need a high level of knowledge, which deters students from pursuing these fields. However, a significant contributing factor to the decrease is students' lack of interest and drive in STEM fields. (Drymiotou et al., 2021; Salzman & Lieff Benderly, 2019). Students' interest and involvement in these areas are further restricted by the lack of different role models. (Jimenez et al., 2019). It is necessary to investigate and put into practice plans and initiatives targeted at raising student enthusiasm and involvement in order to overcome these problems.

The dynamic digital landscape and the ever-evolving learning environment require instructors to use creative techniques in order to motivate students in both professional and educational contexts. Many studies have found that chances for students to study and use their knowledge in real-world situations, exposure to hands-on learning experiences, and role models may all have a beneficial impact on their motivation and engagement in STEM disciplines (Hernandez-de-Menendez et al., 2019; Yannier et al., 2020). Concerns about a lack of people with the necessary STEM skills to support a constantly evolving global economy make STEM education a worldwide problem deserving of concentrated study and discourse (Kennedy & Odell, 2014). According to the National Research Council (2011), this objective has to include enhancing STEM literacy for all students, regardless of whether they intend to major in or seek a career in STEM, as well as expanding the inclusion of women and minorities in STEM fields.

Factors that influence students' perception of STEM include Students' academic and personal development are greatly influenced by their enthusiasm and involvement in the learning process. Numerous studies have shown that interested and motivated students do better academically and are more likely to stick with their course of study or seek careers in it. This statistic emphasizes how crucial motivation and involvement are to a student's progress as well as their entire educational experience and results (Bowden et al., 2021; Howard et al., 2021). Students' motivation, experience, and sense of self-efficacy all influence their attitudes and perspectives toward STEM (Brown et al., 2016; Weinberg et al., 2011). Brown et al. (2016) research on the connections between STEM curricula and students' attitudes revealed that, in comparison to self-efficacy, student interest had a greater influence on students' desire to stick with STEM. These differences may be addressed if pupils were given a long-term exposure to self-determination-promoting activities and interest-driven, inquiry-based projects (Honey et al., 2014). Student experiences in the classroom and in social settings are equally crucial. More precisely, peers have a greater influence on middle school kids because many of them are self-conscious and unwilling to share their opinions with others, and because when children reach puberty, they are less likely to do anything that makes them stand out from the group. Fitting in is crucial, and peer pressure may be quite strong (National Council Teacher Mathematic, 2000).

Next STEM Fair, There has been a rise in interest in engineering fairs, even if the majority of the literature concentrates on the traditional structure of a STEM fair as a competitive event centered on scientific research. Even though the formats of these fairs vary, they usually follow an engineering design process in which students are required to do the following tasks: formulate a question, generate a theory-based hypothesis, design the experiment, conduct the experiment and gather data, prepare and evaluate the data, interpret the results and their conclusions, and communicate the findings (Paul et al., 2016). One way to become involved in the engineering design process before the fair is to produce a product such as the Utah State Board of Education (2023) competition or by actively participating at the fair in person. For both, students must analyze an issue critically and come up with a workable solution.

Then, Increased Interest and Engagement in STEM, Participating in STEM-related activities not only improves students' STEM knowledge and abilities but also increases their enthusiasm and engagement in the subject, according to research. Miller et al. (2018) studies have investigated the impact of STEM contests, such as scientific fairs, robotics, engineering projects, and technology events, on students' proclivities toward STEM occupations. Their results showed that, in comparison to their peers who did not participate in STEM contests, pupils who did so had a greater tendency to show interest in STEM-related occupations by the time their high school careers ended. Koomen et al. (2021) observed that fostering students' interests helps to develop a link between the process and academic instruction. Additionally, it gives students a chance to integrate their cultural and personal strengths with their studies, which raises engagement levels. Feille and Wildes (2021) examined a class of primary school pupils who took advantage of their cultural and personal resources to participate in an engineering fair. The students selected an engineering problem from the real world that needed to be solved, did the necessary research, created prototypes of their best solutions, and then gave a presentation of their method in an engineering fair. It was discovered that following this encounter, the pupils' interest in STEM had increased. The students were exhibiting a passive learning strategy in relation to science and engineering material at the start of the research. These same pupils began to see science and engineering everywhere at the conclusion of their trip. Additionally, the students expressed that they found science and engineering to be far more enjoyable than they had initially thought (Feille & Wildes, 2021). Very similar results were found by Salvadó et al. (2021) who investigated the impact of STEM seminars after school on elementary pupils who were at-risk and participated. After this educational experience, pupils felt that science was more approachable than they had previously believed. One student said, "I thought science was much more difficult and boring, but it can be fun if you put your mind to it and are focused." I now understand that science is more than just math, reading, and writing (Salvadó et al., 2021). These results show that students' interest and involvement in STEM may be increased by being involved in STEM-related activities.

Students' STEM knowledge has been found to grow when they participate in STEM fairs and celebrations. According to a number of studies, students who participate in interactive STEM activities, presentations, and demonstrations at these kinds of events typically learn new scientific ideas, develop their ability to conduct real-world research, and get a better comprehension of STEM subjects (Koomen et al., 2021; Miller et al., 2018). Participation in STEM fairs and fests frequently include designing, constructing, and testing projects. Through this experiential learning method, people can acquire useful information and abilities. Acar et al. (2018) discovered this to be true after carrying out a qualitative investigation with a group of fourth-graders who took part in six curriculum-integrated STEM activities. Based on pre- and post-test results, the STEM activity-participating students' group showed a statistically significant improvement in science achievement in comparison to the control group of children who did not engage in any STEM-related activities. The students in this experimental group also expressed their desire to see more STEM activities in their next courses and how much they appreciated learning more about science and mathematics as a consequence of the STEM activities (Acar et al., 2018).

Comparable results may be seen in a study carried out by Sahin et al. (2014) who investigated the effects of an after-school STEM program on students. According to the researchers' findings, "such after-school program activities may be considered a means to cultivate STEM literacy because students were given the opportunity to acquire both problem-solving skills and experience similar to that which they might encounter in their daily lives, in addition to being engaged in open-ended and real-world problems". According to a meta-analysis on the impact of STEM education in schools, students who get it do better academically and have a major positive impact on the development of scientific process skills, which includes more robust problem-solving and creative thinking abilities (Yildirim, 2016). Results like this provide credence to the idea that children who participate in STEM-related school activities might become more knowledgeable about STEM subjects. The purpose of this study is to find out the students' perception of STEM Fair and the relationship between gender, age, experience, and STEM Fair needs during their involvement in STEM Fair at Phnom Penh Teacher Education College during the 2023-2024 academic year.

METHODS

The study utilized a quantitative research design (Creswell, 2013). Research conducted to examine the perception of STEM Fair and the relationship between gender, age, experience, and STEM Fair needs at Phnom Penh Teacher Education College during the 2023-2024 academic year. Instrument that used:The questionnaire was adapted from Wharton (2019), used as the primary tool for data collection. The questionnaire was conducted for assessing students' perceptions of STEM Fair on students' interest, self-efficacy, and knowledge acquisition, and open-ended questions to evaluate the relationship between gender, age, experience, and STEM Fair needs.

Participant of the study involved 242 students (Obekkhaom Secondary School, Anuwat Primary School, Teuk Laark High School, Chea Sim Samaki High School, Indradevi High School, Sisowat High School, Phnom Penh Teacher Education College, and other schools) who have been involved in the STEM Fair at PTEC during the 2023-2024 academic year.

Data Collection Procedure: The questionnaire was administered to the participants through a paper form. Written informed consent was obtained from the students before data collection. The researchers were present during the consent process to address any queries from the participants (Singh et al., 2023).

Structure of the questionnaire: There were three sections to the questionnaire, each including 28 items. There were 5 questions in each of the first (personal information); the second section had 23 items; however, there were only 5 in the third. In addition, perceptions were categorized into three subscale dimensions: students' interest (Items Q2.1, Q2.2, Q2.3, Q2.4, Q2.5, Q2.6, Q2.7, Q2.8, Q2.9), social self-efficacy (Items Q3.1, Q3.2, Q3.3, Q3.4, Q3.5, Q3.6, Q3.7, Q3.8), and knowledge acquisition (Items Q4.1, Q4.2, Q4.3, Q4.4, Q4.5, Q4.6), and the last section was STEM Fair needs (Items Q5.1, Q5.2, Q5.3, Q5.4, Q5.5). There were four Likert-scale replies for each topic, with 1 denoting "strongly disagree," 2 disagree, 3 agree, and 4 representing "strongly agree." (Wharton, 2019). Relevant components of the STEM Fair Perception were covered by open-ended questionnaire items. Included in the questionnaire were demographic characteristics such as gender, age, and experience (have experience versus no experience).

Data Analysis: To investigate the validity of the questionnaire, we conducted Cronbach alpha analysis, exploratory factor analysis (EFA), employing principal component analysis with varimax rotation, and confirmatory factor analysis (CFA) (Hair et al., 2019).

The researchers analyzed the responses from the participants using a Likert scale to evaluate students' perceptions in three categories: students' interest, social self-efficacy, and knowledge acquisition. For every comparison, means produced with the Statistical Package for Social Sciences (SPSS) 22 were utilized. The maximum score percentages in each ordinal category were linked to a particular interpretation, and the results were presented as mean values for the overall scale, subscales, or items. In addition, STEM Fair Needs interpreted the relationship between gender, age, and experience together with frequency, percentage, p-values, and chi-square.

RESULTS AND DISCUSSION

The perception of STEM Fair was evaluated by 242 students using a questionnaire. All items in the three domains (students' interest, social self-efficacy, and knowledge acquisition) had average scores and standard deviations that were determined using the scores that students had provided on the paper form (See in Table 1). Tables 2, 3, 4, and 5 give all demographic data, including gender, age, and experience, together with frequency, percentage, p-values, and chi-square on STEM Fair needs.

Table 1. Item Mean and Standard Deviation for 23 Questionnaire Items Assessing Students' Perception of Students' Interest, Social Self-Efficacy, and Knowledge Acquisition

Item	Mean	Standard deviation
Students' Interest		
Q3.1 STEM Fair allows me to meet new people	3.02	0.79
Q3.2 I feel confident in my ability to interpret project work after I involved	3.05	0.71
Q3.4 STEM Fair allows me to work with other classmates	3.19	0.71
Q3.5 I feel confident helping others improve their STEM Fair project	3.05	0.68
Q3.6 STEM Fair allows me to have fun with my classmates	3.36	0.66
Q3.7 STEM Fairs can provide me lasting friendships	3.16	0.72
Q4.3 I feel confident I can complete a STEM Fair investigation of high quality	3.14	0.69
Q4.6 STEM Fair is useful in my real life/daily life	3.29	0.61
Social Self-Efficacy		
Q2.2 Involving STEM Fair motivate me to learn science subjects	3.33	0.60
Q2.4 STEM Fair allows me more creative thinking	3.43	0.61
Q3.3 STEM Fair allows me to meet new people	3.27	0.73
Q4.1 Involving STEM Fair allows me to learn new situation	3.31	0.60
Q4.2 I got soft skills during involve in STEM Fair	3.39	0.61
Q4.4 I am confident in my ability to investigate the quality of project work	3.18	0.67
Q4.5 I am confident in present what I have learned from STEM Fair	3.25	0.66
Knowledge Acquisition		
Q2.1 I really enjoy involving in STEM Fair	3.34	0.63

Item	Mean	Standard deviation
Q2.3 STEM Fair extent my Mathematic knowledge	3.08	0.76
Q2.5 I really appreciate all of STEM Fair projects	3.39	0.62
Q2.6 I enjoy listening to each of project works	3.31	0.61
Q2.7 The explain from each group is clearly	3.27	0.62
Q2.9 Involving STEM Fair is as same as supplementary learning	3.42	0.593

Noted: 1: strongly disagree, 2: disagree, 3: agree, 4: strongly agree

The Relationship between Gernder and STEM Fair Needs

The First Column of the Table 2 displays the initial set of chi-square test analyses pertaining to the relationship between gender and the STEM Fair requirements. In order to ascertain whether or not respondents' gender had an impact on their perception of the necessity of each piece of information, chi-square test analysis was done.

Table 2. Results of Chi-square Test between Gender, Age, and Experience

STEM Fair needs	Gender Pearson Chi-square value P-value	Age Pearson Chi-square value P-value	Experienc Pearson Chi-square value P-value
Q5.1: The important of STEM Fair	X2(1)= 1.709 P=0.191 Not significant	X2(16)=4.170 P=0.999 Not significant	X2(1)= 0.473 P=0.491 Not significant
Q5.2: Knowledge aquesition after participant	X2(1)= 2.380 P=0.123 Not significant	X2(16)=5.552 P=992 Not significant	X2(1)= 0.473 P=0.491 Not significant
Q5.3: Future participantion	X2(1)= 1.058 P=0.304 Not significant	X2(16)=15.924 P=0.458 Not significant	X2(1)= 0.007 P=0.935 Not significant
Q5.4: Future involve STEM Fair compitition	X2(1)= 7.490 P=0.006 Significant	X2(16)=27.321 P=0.038 Significant	X2(1)= 2.258 P=0.133 Not significant
Q5.5: STEM Fair related to future career	X2(1)= 0.389 P=0.533 Not significant	X2(16)=19.169 P=0.260 Not significant	X2(1)= 0.022 P=0.882 Not significant

*Significant at 0.05 level

The findings show a correlation between the respondents' gender and a few STEM Fair demands. (View Table 2 First Column.) The information on the importance of STEM Fair (X2(1)1.709, P=0.191), knowledge acquisition (X2(1)2.380, P=0.123), future participation (X2(1)1.058, P=0.304), future involvement in STEM Fair competition (X2(1)7.490, P=0.006), and STEM Fair related to future career (X2 (1)0.389, P=0.533) as STEM Faire needs did not show any gender-based associations, according to the results. However, there was a correlation found between genders and other STEM Faire demands; Table 3 reveals the descriptive statistics of these disparities according to gender.

Table 3. The Relationship between Gender and STEM Fair Needs

STEM Fair needs	Male		Female	
	Yes	No	Yes	No
Q5.1: The important of STEM Fair	111(100%)	0(0%)	129(98.5%)	2(1.5%)
Q5.2: Knowledge aquesition after participant	109(98.2%)	2(1.8%)	131(100)	0(0%)
Q5.3: Future participation	108(97.3)	3(2.7%)	124(94.7%)	7(131%)
Q5.4: Future involve STEM Fair compitition	80(72.1%)	31(27.9%)	113(86.3%)	18(13.7%)
Q5.5: STEM Fair related to future career	109(98.2%)	2(1.8%)	127(96.9%)	4(3.1%)

The Relationship between Age and STEM Fair Needs

In the next set of investigations pertaining to STEM Fair demands, the association between the respondents' ages and the test scores indicated in the Second Column of the Table 2 was examined. Chi-square tests of independence were used to see if the respondents' age groups and their opinions on the importance of each type of information were correlated in any way.

The results demonstrate that there was no relationship between any of the STEM Fair requirements and the respondents' gender. (Refer to the Table 2 Column Two) The findings showed that there was no gender difference in the information on the significance of STEM Fair (X2(16)4.170, P=0.999), knowledge acquisition (X2(16)5.552, P=0.992), future participation (X2(16)15.924, P=0.458), future involvement in STEM Fair competition (X2(16)27.321, P=0.038), and STEM Fair related to future career (X2(16)19.169, P=0.260) as STEM Fair needs. Nevertheless, no association was seen between age groups and additional STEM Faire prerequisites. The gender specific descriptive statistics for these differences are shown in Table 4.

Table 4. The Relationship between Age and STEM Fair Needs

STEM Fair needs	**Age**							
	10-15		**16-20**		**21-25**		**26-30**	
	Yes	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**	**No**
Q5.1: The important of STEM Fair	107 (44.2%)	0 (0%)	86 (35.5%)	2 (0.8%)	44 (18.2%)	0 (0%)	3 (1.2%)	0 (0%)
Q5.2: Knowledge aquesition after participant	105 (43.4%)	2 (0.8%)	88 (36.4%)	0 (0%)	44 (18.2%)	0 (0%)	3 (1.2%)	0 (0%)
Q5.3: Future participantion	103 (42.6%)	4 (1.6%)	82 (33.9%)	6 (2.5%)	44 (18.2%)	0 (0%)	3 (1.2%)	0 (0%)
Q5.4: Future involve STEM Fair compitition	83 (43.3%)	24 (9.9%)	63 (26.0%)	25 (10.3%)	44 (18.2%)	0 (0%)	3 (1.2%)	0 (0%)
Q5.5: STEM Fair related to future career	102 (42.1%)	5 (2.1%)	87 (35.9%)	1 (0.4%)	44 (18.2%)	0 (0%)	3 (1.2%)	0 (0%)

The Relationship between Experience and STEM Fair Needs

The findings of the subsequent round of chi-square analyses between participant experience and STEM Fair requirements are shown in the table 2 third column. The purpose of the chi-square test study was to find any correlation between the respondents' participation experiences and their perceptions of the necessity of each type of STEM Fair. The findings show a correlation between a few STEM Fair requirements and the respondents' overall participation experience.

The findings show that there was no correlation between the respondents' experiences and certain demands at the STEM fair. Refer to the Table 2 Third Column. Findings showed that there was no correlation between experience with knowledge acquisition (X2(1)0.473, P=0.491), the importance of STEM Fair (X2(1)0.473, P=0.491), future participation (X2(1)0.007, P=0.953), future involvement in STEM Fair competition (X2(1)2.258, P=0.133), and STEM Fair related to future career (X2(1)0.022, P=0.882) as needs for STEM Faire. Yet, there was no correlation found between experiences and other STEM Faire demands, and Table 5 presents descriptive statistics of these variations according to experience level.

Table 5. The Relationship between Experience and STEM Fair Needs

STEM Fair needs	Particpantion Experience			
	Have Experience		No Experience	
	Yes	No	Yes	No
Q5.1: The important of STEM Fair	194(80.2%)	2(0.8%)	46(19.0%)	0(0%)
Q5.2: Knowledge aquesition after participant	194(80.2%)	2(0.8%)	46(19.0%)	0(0%)
Q5.3: Future participantion	188(77.7%)	8(3.3%)	44(18.2%)	2(0.8%)
Q5.4: Future involve STEM Fair compitition	160(66.1%)	36(14.9%)	33(13.6%)	13(5.4%)
Q5.5: STEM Fair related to future career	191(79.0%)	5(2.1%)	45(18.6%)	1(0.4%)

Reliability and Factor Structure of Questionnaire

The reliability of the questionnaire was examined using the alpha coefficient created by Cronbach (1970). The questionnaire is considered trustworthy if the alpha value is higher than 0.70. The alpha value in the current investigation was 0.890. Bartlett (1954) created the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO), a technique to assess if factor analysis is appropriate. This statistic represents the percentage of variation in the variables that may be shared. The data are suitable for factor analysis if this measure has a value that is more than 0.4 and ranges from 0 to 1, with values closer to 1 being preferable. Our KMO measure result of 0.887 suggested that factor analysis was appropriate (Bartlett, 1954).

Subsequently, the construct validity of the original questionnaire was assessed using confirmatory factor analysis (CFA). Roff et al. (1997) observed that the structure of the questionnaire had a low goodness-of-fit as indicated by the following measures: standardized root mean residual (RMR=0.056), root mean square error of approximation (RMSEA =0.060), Akaike information criteria (AIC=9064.284), Bayesian information criteria (BIC=9085.553), Tucker-Lewis index (TLI=0.868), Chi-Square test ($p<0.001$), comparative fit index (CFI=0.883), and a rather acceptable fit. Certain items were not representative of the construct, as indicated by the standardized factor loadings ranging from 0.389 to 0.732. As Table 6 demonstrates, every factor that came from confirmatory factor analysis had a strong association.

The independence of the CFA components as well as the original questionnaire factors is called into question by the factor loadings and strong correlations. In order to do additional investigation, exploratory factor analysis (EFA) employing principal component analysis and varimax rotation was used. Table 6 displays the loadings for the first two EFA factors for questionnaire items ranging from Q2.1 to Q4.6. With a total build reliability of 0.890, EFA produced five-factor solutions. After statistical analysis, only three criteria were determined to be legitimate. A single item might be found in some factors, or certain factors had extremely low Cronbach alpha values. In the end, just three factors met the eigenvalue>1 and Cronbach's alpha value>0.7 criterion, and they accounted for 44.893% of the variation between them.

Table 6 provides the factor loadings and commonality. Some items (Q2.8, and Q3.8) were eliminated from the original questionnaire due to extremely low factor loadings. The following is a list of the updated suggested questionnaire factors (domains and items):

Factor 1: Students Interest

Q3.1 STEM Fair allows me to meet new people II
Q3.2 I feel confident in my ability to interpret project work after I involved II
Q3.4 STEM Fair allows me to work with other classmates II
Q3.5 I feel confident helping others improve their STEM Fair project II
Q3.6 STEM Fair allows me to have fun with my classmates II
Q3.7 STEM Fairs can provide me lasting friendships II
Q4.3 I feel confident I can complete a STEM Fair investigation of high quality III
Q4.6 STEM Fair is useful in my real life/daily life III

Factor 2: Social Self-Efficacy

Q2.2 Involving STEM Fair motivate me to learn science subjects I

Q2.4 STEM Fair allows me more creative thinking I
Q3.3 STEM Fair allows me to meet new people II
Q4.1 Involving STEM Fair allows me to learn new situation III
Q4.2 I got soft skills during involve in STEM Fair III
Q4.4 I am confident in my ability to investigate the quality of project work III
Q4.5 I am confident in present what I have learned from STEM Fair III

Factor 3: Knowledge Acquisition

Q2.1 I really enjoy involving in STEM Fair I
Q2.3 STEM Fair extent my Mathematic knowledge I
Q2.5 I really appreciate all of STEM Fair projects I
Q2.6 I enjoy listening to each of project works I
Q2.7 The explain from each group is clearly I
Q2.9 Involving STEM Fair is as same as supplementary learning I

Table 6. Factor Loadings Eigenvalues, Percentage of Variance, and Conbach's Alpha Values

	Factor loading			∝
Item	**Students' Interest**	**Social Self-Efficacy**	**Knowledge Acquisition**	
Students' Interest				0.825
Q3.1	0.669			
Q3.2	0.613			
Q3.4	0.602			
Q3.5	0.652			
Q3.6	0.596			
Q3.7	0.664			
Q4.3	0.510			
Q4.6	0.495			
Social Self-Efficacy				0.747
Q2.2		0.412		
Q2.4		0.474		
Q3.3		0.451		
Q4.1		0.607		
Q4.2		0.692		
Q4.4		0.717		
Q4.5		0.462		
Knowledge Acquisition				0.711
Q2.1			0.625	
Q2.3			0.509	
Q2.5			0.518	
Q2.6			0.691	
Q2.7			0.595	
Q2.9			0.577	
Eigenvalue	6.498	1.606	1.324	
%Variance	30.942	7.648	6.303	

In summary, there are now 8 items in the revised first domain of students' interest, with a variance of 30.942% and a Cronbach alpha of 0.825. Its high Cronbach alpha value makes it the most reliable questionnaire component. The item with the highest factor loading is Q3.1. Items Q3.7 and Q3.5 come next. The item with the lowest score was Q4.6 (Table 6).

Within the revised second domain pertaining to students' social self-efficacy, seven items exhibited a variance value of 7.648% and a Cronbach alpha value of 0.747. Q4.4 was the most-voted item, with a loading value of 0.717. The second-highest score went to item Q4.2 and Q2.2 receiving the lowest mark.

The last component, pertaining to Knowledge Acquisition was studied, the revised third domain, consisting of six items, showed 6.303% variance and the Cronbach alpha value of the third domain is 0.711. The item that was changed initially was Q2.6, with a loading rate of 0.691. Q2.1, which has a loading value of 0.625, is the second-highest item.

The children that took part in the STEM Fair demonstrated a rise in their interest in STEM, social self-efficacy, and acquisition of information. Students who took part in this study also showed a rise in favorable attitudes toward STEM. They demonstrated this by expressing how much they enjoyed the STEM-related activities during the STEM Fair and how much they enjoyed being able to produce independently. Studies conducted by Koomen et al. (2021) and Miller et al. (2018) corroborate these results on the beneficial impact of STEM Fair experiences on students' perceptions of the field. These studies offer further examples of students who, following such experiences, become more enthusiastic and actively involved in STEM. Students' interest in STEM jobs may improve as a result of this higher degree of involvement (Feille & Wildes, 2021; Miller et al., 2018).

Students on the margins, on the other hand, are more likely to have access to non-formal STEM education. The following are some examples of these: "camps, museums, after-school activities, and other places where children can attend (Jackson et al., 2021). Participation has been demonstrated to positively influence students' growth of STEM literacy, despite the transient nature of these chances (Jackson et al., 2021). However, it can be challenging for underprivileged children to attend these optional activities because they are frequently not offered during the school day.

The study's results show that students had fun working with their peers to come up with original solutions to STEM-related challenges during the school day. Positive social interactions of this kind make students feel more confident about their STEM skills, which in turn encourages them to persevere despite obstacles in their career pursuit (Jackson et al., 2021). Based on a chi-square test quantitative analysis, it was determined that there was no significant correlation between four factors, including age, gender, and prior experience with STEM Fair demands. This weaker association is linked to the students' low academic achievement in STEM topics at the secondary school level, their low self-efficacy, and the lack of support from parents and instructors (Tandrayen-Ragoobur & Gokulsing, 2022).

CONCLUSION

STEM fairs such as the one this report highlights are vital resources for fostering curiosity, social self-efficacy, and the acquisition of information in the fields of science, technology, engineering, and mathematics. These gatherings offer a stage for creativity, experiential learning, and teamwork, which will eventually influence STEM education going forward. This research has shown how such efforts can enhance STEM literacy and foster a more favorable attitude about the field, but it is not without limitations. We wanted to learn more about the students' opinions of the STEM Fair, so we used a questionnaire. Out of the 23 questions that were asked using the questionnaire, our analysis found that there were more positive and constructive responses than negative ones. Consequently, a higher proportion of favorable items in the study sample may indicate or promise that participants' perceptions of STEM Fairs will improve. The association between STEM Fair requirements and three specified characteristics, namely gender, age, and experience, was investigated using a Chi Square test for independence. According to the Chi Square results, there was no conclusive evidence linking the three elements to the needs of the STEM Fair. While the data presented here supports the conclusions that STEM Fairs boost favorable perceptions of STEM and improve STEM knowledge, the following practical suggestions are provided for future STEM research.

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