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Perception of Teachers Regarding Role of STEAM Robotics laboratories in Removing Boredom from Learning Science at the Elementary Level

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Abstract

Educational technology is finding new ways to attain the attention of students towards science. One of the innovations in teaching science in the integrated classroom at STEAM robotics laboratories. The purpose of the research is to examine the perception of teachers regarding the role of STEAM robotics laboratories in removing boredom from science classrooms. The objectives of the research were to find out teachers' perception regarding students' boredom in learning science in the integrated classroom and innovative STEAM robotics and to analyze learners' interest in learning science through STEAM robotics concerning their teachers at the elementary level. The population was the teachers having experience of teaching science through STEAM robotics and traditional method of learning science in the science classroom. A sample of eighteen teachers was selected by the universal sampling technique. The quantitative research methodology was used and descriptive statistics were for analyses of data. The responses were analyzed through descriptive analysis. The results were concluding by taking the mean of each item. The results showed that the students are participating actively in STEAM robotics classrooms as compared to the traditional method of learning science. The results depicted that STEAM robotics laboratories help increase learner's interest and remove boredom from science learning.

Keywords: boredom from learning science, science teachers, STEAM robotics laboratories

Introduction

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Nowadays different methods are introduced to eliminate the boredom of learning and make classes effective. Most students lack the theories and principles of science learning, but if the classroom environment becomes interactive, this will affect their interest. The technological revolution is forcing educators to think about it so that engineering and technology are integrated into science, math, and the arts. This integrated educational model is the STEAM educational model. The STEAM educational model offers students the opportunity to learn in an integrated classroom through practical practices. Educators are attracted to frequent innovations in science and technology, so they will introduce robotics to education. Educational technology is presented day by day, which will also surprise teachers and policymakers. To compete with the rest of the established countries, Pakistan is working on new educational projects.

Progressively robotics is very important for next-generation students. To succeed in the career goals within the era of the 21st-century learners must attain problem-solving, logical, critical thinking, and collaborative skills. The vital role played by technology firstly is assimilating these skills. Secondly, STEAM education is exploring the ways to learn from technology. Thirdly SREAM robotics education provides innovative challenges and opportunities for the learners at the school level in developing unique concepts, and higher-order learning skills (Afari & Khine, 2017). STEAM has become an educational model that has structured the traditional academic subjects of science, technology, engineering, the arts, and mathematics into an additional framework that helps design integration programs. This integrated educational model of the STEAM programs covers all aspects of these discipline-specific advancements along with the criteria of a single discipline, about holistic and inclusive education (Kim, 2016).

STEAM education will enable research, encourage commitment and push boundaries. Artistic participation in STEM encourages students to interpret the material based on their personal experience, thus increasing the value and total pleasure of learning (Land, 2013). The traditional reading method makes the mistake of assuming that students understand and learn instantly what the instructor says and puts on the board, even though they offer the opportunity for the teacher to inspire and motivate students. Now, a teaching method in the daytime class (pedagogical teaching model) is rapidly criticized, while, on the other hand, it is the largest reality that has managed to continue during the period of longitudinal bonding at the rate of many technological developments. (Kamienski & Radziwill, 2018). The research aims to analyze teachers' perception of the role of STEAM robotics laboratories in eliminating

boredom in the science class. Boredom can be eliminated with the student-centered approach. Although in the integrated classroom of the STEAM robotics laboratories, the integration of the arts makes learning fun. These are the objectives of the STEAM educational model to make student-centered learning and develop higher-order thinking skills. The other goals of this educational model are to compete with the challenges of the 21st century and increase students' problem-solving skills.

As in previous studies, researchers examined clarifying the history of STEAM to STEM. Although there are many studies related to Steam education and students' higher-order thinking skills. Researchers are discovering the effect of steam education on students 'cooperative learning, students' critical thinking, and computational skills. The concept of STEAM robotic is generally practiced in the private sector of Pakistan at the elementary level. So researchers initially investigated its effectiveness by themselves for its significance in the development interest in students for science learning. The findings of this study will help the new researcher in investigating its practices at various levels of the teaching-learning process.

Statement of the Problem

Private schools are using effective strategies of active and cooperative learning in STEAM robotics laboratories because of frequent developments in the field of educational technology. Different private sector schools of Pakistan take initiative to teach students through modern modes of teaching. This innovation and the researcher's previous research results and observations force the researcher to study the perception of teachers regarding the role of STEAM Robotics Laboratories in removing boredom from the science classroom at the primary level in Pakistan. Moreover, this study was also the level of students' interest regarding STEAM Robotics Laboratories concerning their teachers at the elementary level.

Objective of the Study

1. To find out teachers' perception regarding students' boredom in learning science in the integrated classroom and innovative STEAM robotics.

Theoretical Framework and Conceptual Framework

The study was based on the STEAM education model is given in 2015 by NELS (national education longitudinal survey). The STEAM (education model is the integration of art and science along with technology. STEAM education models enable students through inquiry learning, cooperative learning, and developing their higher-order thinking skills especially problem-solving. A teacher's perception is the teacher's opinion based on her experience.

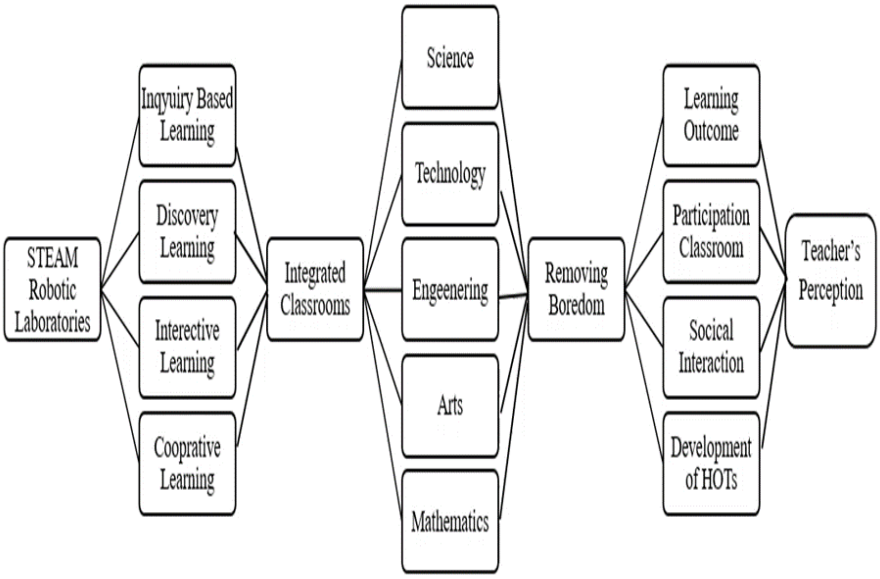


Figure 1: Theoretical and Conceptual Framework of Teachers' Perceptions regarding the STEAM Robotic Laboratories to Remove Boredom

Literature Review

At the first glance, STEAM seems to be attractive and innovative for an old and consolidated educational system. Since at least 1992, the National Science Foundation (NSF) has started funding educational projects that integrate science and art. After a while in January 2011, the Rhode Island School of Design (RISD) for an NSF-funded seminar called "Bridging STEM to STEAM: Development New Frameworks for Art-Science-Design Pedagogy" was visited by sixty art leaders, design, STEM

educational research areas. They had described their goal in their grant proposal to the National Science Foundation (NSF), were to "initiate discussions on how to link STEM teaching practices and creative problem solving" (Davidson & Simms, 2017).

Science, Technology, Engineering and Mathematics (STEM) is a general program that has been planned in the teaching of science, technology, engineering, and mathematics in learning which develops an interdisciplinary approach and helps improve problem-solving skills in students. In the last era, STEM education draws worldwide attention to the improvement of science and mathematics as an integrated discipline and at the same time to technology. STEMs are often educated outside of creativity, art and design, because STEAM (science, technology, engineering, art, and mathematics) is an extension of science, technology, engineering and mathematics (STEM), to integrate "art "Art is the positive, rich and powerful element of civilization (Liliawati, Rusnayati, Purwanto & Aristantia, 2017).

Each of the five subjects of the STEAM educational model acquires mutual value and concentration. To create new knowledge about parts or solve problems through STEAM, students need to be assembled and use tests. As a result, students end up learning daily as they explore, play in an interactive learning environment, and engage in new experiences. STEAM's new skills and theories help students explore the world around them, so they can learn from experience. Various researches and studies have shown that there is a positive relationship between future success at school and the first STEAM educational experiences (Nicholes, 2018).

STEAM education is established as a pedagogical approach in which students demonstrate advanced concepts and reflect critically and creatively while solving connection problems between these disciplines.

STEAM instruction improves:

1. Academic results and achievements.
2. Encourage learning opportunities.
3. Logical and analytical skills of the student.
4. Creative skills of students.
5. Student learning experiences.
6. Student innovation to solve real-world problems (Erba, 2019).

STEAM's pedagogical approach to teaching represents an evolution towards an innovative educational model that enhances the learning process, as well as improving learning outcomes through the use of the student-centered approach. The learning experiences of students involve

two or more STEAM standards and the invention of learning conventionally exploits the art form itself (Erba, 2019).

Integration of arts "A" in STEAM

A creative mindset was a difficult STEM educational model, to fill this gap, the arts merged into STEM and became a STEAM educational model. Scientists, engineers, mathematicians, and technology developers must work together to accelerate the pace to solve problems creatively. The subjects integrated into the STEAM educational model were similar in their approach to learning, while autonomous discovery and active learning when interacting with technology are at the heart of STEAM learning (Gunn, 2017).

Students participate in the painting so that they can feel the paintings through their hands and observe the desired change in the paper. At one point, students were allowed to play a role, so they knew the characters and understood them correctly, they could also touch and feel the dioramas they symbolized artistically. These types of creative learning approaches improve students' sensory exploration because drama and drawing allow them to share what they know and feel, which makes them clear to read or write. While the music was linked to STEAM skills with the integration of arts such as numbering and recognition of patterns (Liliawati et al., 2017).

STEAM Robotics Teaching

Various educational research specialists have made robotics an effective educational tool and subject, with a series of publications dedicated exclusively to the functioning of the Lego Mind Storms kit at all levels of education, from school to university. Educational robotics projects are reported because they help improve performance in math, physics, and engineering lessons. Although the evidence in the teachers' report mainly indicates that they achieve positive results through their use in the form of learning outcomes. Robotics has been offered a special integrated pedagogical control because it is a multidisciplinary field that includes a combination of different disciplines, including mathematics, electronics, computer science and programming, physics, design, and psychology. Based on the results of previous research, he recommended that:

1. The educational value of robots lies in their functioning.
2. Use or expand knowledge to identify problems and support them.
3. Robots are a particularly motivating technology.

4. They are concrete, complex, and connected to deep human needs (Afari & Khine, 2017).

Educational robotics became an important educational tool for STEM K-12 teaching when the LOGO programming language was developed in 1967. These informal environments have the potential to provide an ideal environment capable of tacitly feeding children's lifelong learning skills through curiosity, observation, and interactive activities (Anwar, Bascou, Menekse & Kardgar, 2019).

The study was born from how these technologies can support, direct and improve the user's thinking and cognitive processes, as they help students use their mental efforts fruitfully and efficiently. We could say that educational robotics software, as well as educational robotics kits, belong to the large family of "cognitive artifacts": the first allows you to manipulate mental concepts, the second allows students to manipulate real objects, to build mental sense and the potential to use robotics as an educational tool is enormous. The project-based learning methodology allows the researcher to collect a wide variety of data, as it involves students in the exploration and research of new concepts. Students do not feel appreciated and feel free to write and express their opinion (Gabriele, Bertacchini, Tavernise, Vaca-Cardenas, Pantano & Bilotta, 2017).

STEAM Education give base to STEAM Robotics Laboratories and Clubs

The advanced STEAM approach to education requires the right tools and resources. Teachers have a wonderful challenge and the future depends on the skills and knowledge they can teach their students (Daugherty, 2013).

Use of robots that help teachers and educators to teach students mechanics, engineering and programming, through production kits for green screens and animation studies that stimulate the expression of students, transforming them from simple consumers into producers, learning the digital literacy and inventors' rights. The teacher should preview the full range of all available STEAM products before teaching. Here's how STEAM education (science, technology, engineering, art, and mathematics) supports the idea of robotics labs (Kamienski & Radziwill, 2018).

Use of STEAM Robotics Clubs instead of STEAM Education Schooling System

In Pakistan students are learning seven subjects at primary and elementary English, Urdu, mathematics, science, social studies, arts, and Islamic studies. This is very difficult to integrate all these subject in one STEAM education curriculum. Pakistan should increase productivity as Pakistan is under developing country so therefore, we are using STEAM Robotics Clubs Instead of the STEAM education schooling system. In Pakistan, STEAM education is offered as a weekend course or summer course. Some Schools belonging to private sectors use robotics in their curriculum as a separate subject and this robotics education is based on STEAM education and curriculum. Students are engaged in weekly projects and learn through the inquiry method.

Boredom in Science Learning

Boredom is the state of feeling bored and unhappy it can because in learning because of following reasons:

1. Monotonous in learning strategy
2. Lack of variation of teaching methods
3. No colorful classrooms
4. No practical learning
5. Passive learning

The effect of this boredom results as:

1. Lack of interest in learning.
2. Mentally not present in classrooms.
3. Bad results mean learning outcomes will affect.
4. Become dull and depressed with no social interaction.
5. No permanent learning.
6. Cannot think out of the box means low development of HOTs

Removal of Boredom through STEAM Education

There is a body of daily knowledge that supports the innovative trend of enriching STEM in STEAM teaching. Basic approaches after adding arts, skills, and creative support to learning math and teaching practices, particularly concerning other areas of knowledge and culture. However, there are only a few evidence-based studies to confirm these practical experiences. Therefore, relevant and reliable research is urgently needed to expand STEAM's emerging movement and activities (Guyotte, Sochacka, Costantino, Kellam & Walther, 2015).

Robotics teaching has described that robotics has a potential impact on students' learning in different subjects (physics, math, engineering, computer science, etc.) and on personal development, including cognitive and metacognitive and social skills, such as research skills, creative thinking, decision making, problem-solving, communication and teamwork, all essential skills needed in the 21st-century workplace (Afari & Khine, 2017).

However, STEAM education is becoming increasingly common in primary and secondary education and it is equally important to implement it in higher education and beyond. As concepts become more advanced, students can establish better and more sophisticated connections with the real world (Daugherty, 2013).

STEAM programs expose students to the concepts of "grand representation" seen in the real physical environment as a continuous relationship with learning, which brings out STEAM as an empowerment initiative and promotes the idea that education benefits tangibly from all academic fields. Moreover, STEAM education remove boredom as:

Integrated Classrooms

STEAM's efficiency is not astonishing: "Science, technology, engineering, mathematics, and the arts have almost alike intellectual ancestors: some of the same philosophical foundations, some of the inquiry-based teaching (Nicholes, 2018).

Creativity is a highly sought-after skill in today's fast-paced education system and growing social, emotional, and intellectual needs. Knowledge of the content is not enough to be successful today; how to use knowledge innovatively and effectively (Zhbanova, 2019).

STEAM Education and Cooperative Learning

STEAM Robotics laboratories are highly collaborative, students work together to acquire innovative material using different facts. STEAM students learn to share their responsibilities and efforts by working on group projects that integrate different disciplines (Mosley, Ardito & Scollins, 2016).

Several STEAM educational projects contain teamwork and thoughtful dialogue in which students exchange ideas and discuss ways of solving problems. Through the use of these meaningful activities, students learn to share responsibility, compromise, listen to each other and encourage each other. About students, they can approach STEAM

education with enthusiasm or curiosity, while others may be more shy or apprehensive (Guyotte et al., 2015).

Higher Order Thinking Skills

STEAM robotics is that the entrance to new academic technologies, it'll improve higher-order thinking skills among students (Anwar et al., 2019). STEAM artificial intelligence permits students to assume critically, logically, analytically and develop ability skills. In summary, he develops higher-order thinking skills (HOTS) within the student (Gabriele et al., 2017).

Higher-order thinking skills (HOTS) were referred to as advanced psychological feature skills that embody analysis, evaluation, synthesis, judgment, and creative thinking. Higher-order thinking needs students to travel on the far side merely basic cognitive process the facts. Instead, students are calculable to coach with the fabric they're learning.

Bloom was the primary to introduce the thought of "lower" and "higher" thinking skills. In the 1950s, Bloom's taxonomy was developed and continues to be wide standardized by educators nowadays. Within the context of Bloom's taxonomy, we expect that skills are shaped step by step, ab initio with the best skills (recall and understanding), developing with additional advanced skills (application and analysis), and ending with thinking skills. Higher-order as synthesis, analysis, and creation (Kamienski and Radziwill, 2018).

While students' higher-order thinking skills (HOTS) acknowledge relationships between concepts, mix and apply ideas to solve a distinct downside or manufacture fully innovative concepts that supported what they need to be learned. It’s the method of exploitation thought extensively to search out a brand new challenge. Higher-order thinking needs somebody to use innovative info or data that he has obtained or obtained, and thus manipulates info additional to become responsive during a new scenario. STEAM clubs have created a valuable contribution to HOT students (Erba, 2019).

STEAM Education and Critical Thinking

STEAM educational projects teaching outcomes need students to assume consistently concerning issues, exploitation the data they learn on the method of technology and engineering to search out the most effective solutions. The mingling of the working syllabus additionally involves numerous components of the student's mind, so they will see not solely

their however additionally the globe through totally different aspects (Mosley et al., 2016).

STEAM Education and Computational Thinking

CTI robotics may be a kind of academic STEAM robot that will improve students' computational thinking during this type of learning that students use computers to unravel issues. Since a haul is often resolved earlier, the matter itself and therefore the means that of determination it should be understood. Computational thinking includes determination this many-sided downside and disputes it into a variety of smaller, handier issues (decomposition). Every one of those minor issues is often thought of individually, taking under consideration however connected issues have antecedent been resolved and focusing solely on the vital details, ignoring moot info like abstraction. The subsequent steps square measure straightforward steps or algorithmic rule rules for determination every of the smaller issues that may be designed (Bocconi, Chioccariello, Dettori, Ferrari & Engelhard, 2016).

STEAM Education and Problem-Solving

Students from developed countries tend to not do also as students from different countries once it involves international assessments that live mathematics, science, and downside determination skills. STEAM academic comes to provide students the chance to unravel issues in distinctive ways as they're forced to use a spread of ways to unravel issues that arise throughout this kind of activity (Anwar et al., 2019).

By trial and error, learning to require risks, and discovering the way to "think outside the box", students abandon the ordinarily used approach to use a famous methodology or formula to unravel a group of issues in one step. And due to STEAM, they need to unravel it during an additional artistic method than with non-linear means that (Khanlari, 2013).

Therefore, a review of the literature shows that STEAM education is predicated on Jhon Dewey and Bulgarian monetary unit Vygotsky, as they need to be argued in progressive learning theories and psychological feature development theory that for education to be simpler, youngsters ought to have opportunities to learning that permits them to link current content to previous expertise and data. Dewey's theories were the requirement for college students to be directly concerned in their surroundings, in what was referred to as experimental learning, wherever the knowledge attained from imitations made of natural settings, this approach later light-emitting diode to different approaches similar. Like

learning concerning issues and learning concerning queries. STEAM is additionally sculptural by Jean Piaget's art movement theory, primarily art movement is knowledge-based student expertise building.

Methodology

Research Design

The researchers have used a descriptive survey research design as researchers want to study the perception of teachers regarding the role of steam robotics laboratories in the removal of boredom from science classrooms. This research design was quantitative. This design was applied because researchers can collect all the responses from the respondents (Fatima, 2019). The study was biased-free and more reliable. A survey method was utilized as a focused research design because it gave worthy results of respondents' attitudes and perceptions (Fatima, Zamir, Ali & Fatima, 2018). So, therefore, researchers used the survey method to study the perception of the teachers.

Population

All the teachers who were practicing STEAM Robotic Laboratories of Nova City School were constituted as the population of the study.

Sample and Sampling Technique

The sample was then targeted group or set of the population (Fatima, 2019). The selected sample was 18 teachers of School at Wah Cantt. This sample was derived through the universal sampling technique as it refers to the selection of sample where not all the respondents in the population have the same profitability of being involved in the sample and each one of them, the probability of being selected is anonymous (Fatima, 2019).

Instrumentation

A questionnaire was developed for collecting the teacher's perceptions and was based on the selected-response statement for quantitative results. The questionnaire was designed in the context of research questions that had composed according to research objectives. The questionnaire was based on five themes of STEAM Robotic laboratories such as learning outcome, learner's participation, social

interaction, higher-order thinking skills, and effectiveness of STEAM robotics laboratories. This concept was developed by NELS (National Educational Longitudinal Survey) in 2015. Each theme had a set of items based on the objectives of the research. There were 22 items in a questionnaire. The questionnaire was based on Likert scale as Strongly Disagree = "1", Disagree = "2", Neutral = "3", Agree = "4" and Strongly Agree = "5".

Table 1
Reliability of the Scale

Sr. No	*Scale*	*No. of Items*	*Cronbach Alpha*
1	Perceptions of teachers regarding the role of STEAM Robotic Laboratories to remove boredom	22	.555

Cronbach alpha value (.555) shows that all the items are reliable and retain for final administration.

Data Collection

Researchers were collecting the data through a personal visit. Firstly, the researcher had collected teacher's data from the administration of the school then they come to know that 18 teachers had both experiences. Then researchers take a questionnaire to them so they filled them.

Data Analysis

Responses through respondents were analyzed through descriptive analysis. Researchers had utilized the descriptive statistics applied through the. Data were analyzed through the mean score and percentage for quantitative analysis. The results were concluding by taking the mean of each item. Mean was used for analysis because it measures the attitudes and delivers a basis for judgment.

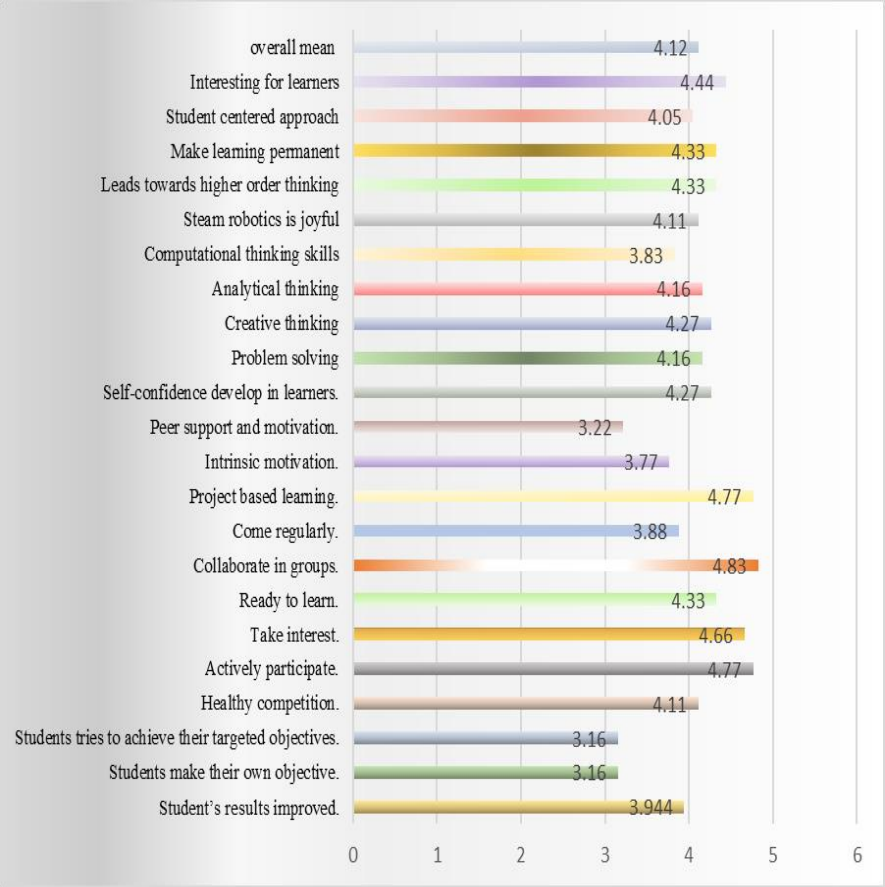
Results

Table 2

Percentage responses of teachers regarding STEAM Robotics Laboratories.

Sr. no.	Items	S.D	D	N	A	S.A
1	Student's results improved.	0	0	22.23	61.12	16.67
2	Students make their objective.	0	33.34	16.67	50	0
3	Students try to achieve their targeted objectives.	0	27.78	27.78	44.45	0
4	Healthy competition.	0	0	11.12	66.67	22.23
5	Actively participate.	0	0	0	22.23	77.78
6	Take interest.	0	0	0	33.34	66.67
7	Ready to learn.	0	0	11.12	44.45	44.45
8	Collaborate in groups.	0	0	0	16.67	83.34
9	Come regularly.	0	0	33.34	44.45	22.23
10	Project-based learning.	0	0	0	22.23	77.78
11	Extrinsic motivation.	0	16.67	44.45	38.89	0
12	Peer support and motivation.	0	17.67	43.45	38.89	0
13	Self-confidence develops in learners.	0	0	0	72.23	27.78
14	Problem solving	0	0	11.12	61.12	27.78
15	Creative thinking	0	5.56	27.78	44.45	22.23
16	Analytical thinking	0	0	0	88.89	11.12
17	Computational thinking skills	0	5.56	27.78	50	16.67
18	Steam robotics is joyful	0	0	0	88.89	11.12
19	Leads towards higher order thinking	0	0	0	66.67	33.34
20	Make learning permanent	0	0	0	66.67	33.34
21	Student centered approach	0	0	11.12	72.23	16.67
22	Interesting for learners	0	0	0	55.56	44.45

Table 2 shows that teachers mostly agreed with the STEAM robotics laboratories aspects such as it improved student's results (61.12%), create healthy competition between learners (66.67%), develops self-confidence in learners(72.23%), develops learners problem-solving skills (61.12%), develops learners analytical thinking skills(88.89%), is joyful than that of traditional classrooms(88.89), helps to lead learners towards higher-order thinking skills (66.67%), helps in making learning permanent (66.67%), is learners centered approach (72.23%). Similarly, table 4.1 shows that teachers strongly agreed with the STEAM robotics laboratories aspects such as it improved student's results engage learners in active learning (77.78%), help teachers to captured learners attention, and learners take interest in learning (66.67%), enable students to collaborate in groups (83.34%), indulge learners in project-based learning (77.78%).



Graph 1: Mean Value of each Items

Graph 1 shows the mean value of each item regarding teachers' perception regarding the role of STEAM Robotics Laboratories in removing the boredom from science learning at the elementary level. The overall mean value (M=4.12) shows that teachers agreed that Steam Robotics laboratories were playing a vital role in removing the boredom from science learning at the elementary level.

Table 3

Students' Interest in STEAM Robotic Laboratories concerning their Teachers

Calculated	Mean
Learning Outcome	19.78
Learners' Participations	26.61
Social Interaction	11.78
Higher Order Thinking Skills	16.89
Effectiveness Steam Robotic Classrooms as Compare to Traditional Classrooms	20.67

Table 3 shows the mean scores of learning outcome (M=19.78), learners' participation (M=26.61), social interaction (M=11.78), higher-order thinking skills (M=16.89), and effectiveness of STEAM Robotics classrooms as compare to traditional science learning classroom (M=20.67). It means that STEAM Robotics Classrooms increase student participation while their social interaction has not been an increase as compared to other aspects of STEAM Robotic Laboratories because they are not confident about their extrinsic motivation (44.45%) and peer support (43.45%).

Discussion

The current study had found that teachers mostly agreed with the STEAM robotics laboratories aspects such as it improved student's results, create healthy competition between learners, develops self-confidence in learners, develops learners problem-solving skills, develops learners analytical thinking skills, are joyful than that traditional classrooms, helps to lead learners towards higher-order thinking skills, helps in making learning permanent, learners centered approach, engage learners in active learning, help teachers to captured learners attention and learners take interest in learning, enable students to collaborate in groups and indulge learners in project-based learning. This result was quite similar to the work of Khanlari (2013), because of this innovation in educational trends, a student's experience with some form of STEAM education at high school interprets to a considerable benefit when applying will result as essential skills of critical thinking and problem-solving. Similarly, this study depicted that the mean scores of learning outcome, learners' participation, social interaction, higher-order thinking skills, and effectiveness of STEAM Robotics classrooms as compare to traditional science learning classrooms. This result was similar to the work of Mosley et al. (2016) and Kim (2016) who said that STEAM robotics laboratories environment was highly cooperative students were learning by doing, while the classroom

environment was one of the factors that can affect students, higher-order thinking as the classroom environment.

Conclusion

Learning outcome, learners' participation, higher thinking skills, and effectiveness of STEAM Robotics Classrooms than traditional science classrooms were increased as compared to social interaction STEAM Robotics Clubs.

Recommendations

There are the following recommendation:

1. Government should collaborate with both public and private sectors to promote new ways of learning by including STEAM robotics as a subject at the primary and elementary levels.
2. STEAM robotics teachers' training programs will be held for all primary and elementary level teachers that promote learning outcome, learner's participation, social interaction, and higher-order thinking skills, like STEAM robotics laboratories.

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