Elementary School Female Students' Attitude towards STEM

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ABSTRACT

STEM has unraveled itself as an integrated teaching learning approach that fosters ingenuity and creativity, instill innovation, inculcate critical thinking, teach problem solving and encourages experimentation. Despite of modern advances, female representation in STEM workforce is low as compared to males. Studies show that girls lose their interest and intent to major in STEM fields during their middle school. The purpose of this study was to develop female student's attitude towards STEM at elementary level. True experimental design of quantitative approach was employed to conduct the study. The population was consisted of all the girls students of govt. school at elementary level. The sample was comprised of 8th grade female students of a public sector school in Lahore. To collect data a questionnaire developed by Friday Institute for Educational Innovation (2012) was adapted. The study was concluded on the basis of the findings that there was a significant effect of STEM integrated teaching on the female student's attitude of experimental group as compared to the results of control group. It is recommended by the researcher that similar kind of study should be conduct using mixed method approach to validate the results of the study.

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1. Introduction

Technological advancement has made education much more interesting and adaptive. People tend to learn on the basis of its prospective outcomes. Science and technology, as a joint systematic venture, contributed to set new trends in education. STEM learning is one of the latest trends in education which is adopted by the leading education systems of the world.

The term STEM was first suggested by one of the Directors of National Science Foundation in 2001 (Selvi, 2015). STEM is an acronym used for 'Science, Technology, Engineering and Mathematics' (Moomaw, 2013). It is actually an integrative approach that makes STEM a well-knitted curriculum in which four disciplines cannot be separated (Roehrig, 2012). The relation between STEM and economic development of the country has always been focused by the researchers. They always focus on the STEM integrated teaching which will lead to technological advancement (Maltese, 2010).

STEM education is a dire need of Pakistan to make it prosper in the 21st century (Awan, 2017). Our students need education having strong foundation in STEM areas to face the upcoming challenges of the ever-changing world of technology (Anwar, 2017). Today the demand for skills has entirely morphed. It has shifted from mundane manual routine tasks to non-routine interactive tasks. (Malik, 2017)

Advancement towards STEM is crucial to our future success. Bridging the gap between current education system and the workplace competencies is very important (Jang, 2016). Being a developing country, we can only prosper if we focus on the constant supply of highly competent and technically trained talent. The Global Gender Report 2017 ranks Pakistan at 136 out of 144 countries. The gender stereotype is really a big issue in Pakistani education system. Although, girl's enrollment is much higher in medical colleges as compared to boys yet their representation in STEM fields at workforce level is very low (Dasgupta, 2014). So the need of the hour is to make women aware of their identity as a foundation block in the development of the country (Mujtaba, 2015). With the world advancement, people having skills in science and technology are always high in demand. Countries try to build their workforce capacity in latest trends of science and technology just to compete with the global trends in economy and innovation (Yildirim, 2015).

A study conducted on the Indonesian students revealed that there is a significant relationship among the dimensions of attitudes towards STEM (Suprpto, 2016). Another study was conducted to examine project based learning (PBL) by utilizing integrated STEM technique. The outcome of the survey showed that there is a noteworthy contrast in the attitudes of the participants after employing PBL approach. They realized that by acquiring professional science knowledge, they not only can make their lives better but make this world a efficient place to live in (Tseng, 2013). PBL approach has a significant potential to engage the students in STEM activities and workable solutions for the real world problems (J Mong, 2013). PBL approach can give much better outcomes when it is well designed by the instructor and well demonstrated by the learners (Capraro, 2013).

This study will help to evoke the interest among females to take an active part in the economy of the country to make it prosper. STEM integrated teaching will help them to be better logical thinkers, problem solvers, inventors, qualified innovators and technologically literate persons (Stohlmann, 2012). Technological advancement is directly affecting the economic development of the country (Kennedy, 2014). STEM integrated teaching will set a basis for the overall attitude development of the female students to take an active part in the technological workforce (Milgram, 2011). They will be able as qualified high tech workers (Melguizo, 2012).

2. Research Question

The research question under consideration was 'to what extent STEM integrated teaching effect the female student's attitude towards STEM?

3. Methodology

Positivism is the research paradigm of the current study; quantitative approach under Qusai experimental research design (non-equivalent group pretest-posttest design) was utilized to conduct the study. In the current study, STEM integrated teaching is an independent variable which was manipulated by the researcher where as its effect on the female student's attitude towards STEM is a dependent variable. Population of the study was all the female students enrolled in government schools in Lahore at elementary level. Sample was comprised of 8th grade students of a public school. After getting permission from the principal of Govt. Practicing Girls High School Township, Lahore, the students were assigned to control and experimental groups randomly.

4. Procedure

Two groups were selected as experimental and control group to carry out the intervention of the current study. There were 50 students in each group. The duration of the class was 35 minutes. General Science was the subject which was taught by the researcher through STEM integrated teaching method. Students were taught through PBL (project based learning) approach by transferring the control of learning process to the students. Engineering design process was employed to foster curiosity and critical thinking among students. Experiments were performed by the students in a science lab; handling scientific apparatus was an exciting experience for the students. Interesting animations and

experiments were presented on computer to wipe out the misconceptions about science. Success stories of females working in the field of science and technology were introduced to the students to enhance their interest in science. Students were exposed to a different leaning environment by providing them hands-on experiential learning.

5. Instrumentation

The data were collected by using the Elementary School STEM – Student Survey that is developed by Friday Institute for Educational Innovation (2012). The questionnaire has four parts---Science, Mathematics, Engineering and Technology and 21st century learning skills. Each part has different number of items in it. The survey questionnaire was adopted with the permission of its authors.

6. Findings

Independent sample t test was employed to discover the effect of STEM integrated teaching on the development of female student's attitude towards STEM related to experimental and control group. Results of the study are given below:

Table: 1

Comparison between the mean scores of experimental and control groups

Discipline	Group	Mean	SD	df	t	P
Mathematics	Experimental Group	24.25	5.912	98	3.551	<.001
	Control Group	21.67	4.221			
Science	Experimental Group	27.47	5.982	98	4.220	<.001
	Control Group	24.28	4.621			
Engineering & Technology	Experimental Group	30.18	6.442	98	4.433	<.001
	Control Group	26.44	5.448			
21 st century learning skills	Experimental Group	38.40	8.744	98	7.605	<.001
	Control Group	31.53	7.605			
Overall	Experimental Group	120.30	22.97	98	17.912	<.001
	Control Group	103.92	17.91			

The above table displays results of the *t*-test for the comparison of mean attitude score of the subjects in the experimental and control groups. The first comparison shows that female participants of the experimental group had higher mean attitude score towards mathematics as compared to the control group, $t(98) = 3.551$, $p < 0.001$. This shows a significant effect of STEM integrated teaching on the attitude towards mathematics in the experimental group.

The next comparison shows a significant effect of STEM integrated teaching on the attitude of experimental group towards science, $t(98)=4.220$, $p<0.001$. It is therefore concluded that mean attitude score of the experimental group towards science was significantly higher than the mean attitude score of the control group.

Similarly, a highly significant effect of STEM integrated teaching on the attitude of experimental group towards engineering and technology is reported by the *t*-test, $t(98)=4.433$, $p<0.001$. It is therefore concluded that mean attitude score of the experimental group towards engineering and technology was significantly higher than the mean attitude score of the control group.

The effect of STEM integrated teaching on the 21st century learning skills was also compared between the two groups. The *t*-test has revealed that there is a highly significant effect of STEM integrated teaching on the mean attitude score of experimental group towards 21st century learning skills, $t(98)=7.605$, $p<.001$.

The final comparison is made on the overall mean attitude scores of the experimental and control groups towards STEM. The *t*-test has confirmed that there is a highly significant effect of STEM integrated teaching on the mean attitude of experimental group participants towards STEM, $t(98)=17.912$, $p<0.001$. It is therefore concluded that the mean attitude score of the experimental group towards STEM was significantly higher than the mean attitude score of control group due to STEM integrated teaching.

7. Conclusion and Discussion

It was concluded on the basis of the findings of the current study that the effect of STEM integrated teaching on the development of female students attitude towards STEM at elementary level is significant as compared to the results of the control group. A study conducted by Rachel Lynn-Pleis McKenna (2016) also showed the results that STEM integrated teaching is helpful to develop student's attitude towards STEM. The results of the current study are compatible with the previously conducted study by Heaverlo (2011) that concluded that there is a significant effect of STEM integrated teaching on female student's attitude towards STEM.

It is recommended that a study by using mixed method approach to validate the results of the study may be conducted in future.

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