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MEDIATING EFFECTS OF ICT ON THE RELATIONSHIP BETWEEN STUDENTS' ATTITUDE AND ANXIETY TOWARDS SCIENCE

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ABSTRACT

This study analyzes the impacts of technology on the relationship between students' anxiety and their attitude towards science through the mediating analysis. This method was based on 350 questionnaires filled by only science students in Lahore, Pakistan. The study showed that students' attitudes towards technology for learning mediate the relationship between their students' anxiety and attitudes towards science completely. Moreover, male students are more inclined towards science as well as technology learning as compared to female students. however, anxiety towards science is higher in female students as compared to male students.

Disciplinary: Education Sciences (Information Technology in Education).

1. INTRODUCTION

Education is a process that develops all those capabilities in an individual that a person needs to fulfill one's responsibilities in society. Investment in the educational system leads to higher economic growth (Bridsall, 1999). The standards of education system build a better quality of human resources and thus leads to the development of a nation (Khalid & Khan, 2006). Governments, schools, and teachers altogether set these standards. For a higher quality of education, everyone needs skills, professionalism, and educational expertise. It will not only assist the educational department, facing the challenges of upcoming new technologies but also it will be helpful in the teaching and learning process for different subjects of science.

In Pakistan's educational system, science is a compulsory discipline from grade one to eight; after that, students may choose between science and arts. At the secondary level, students are opting for science subjects like physics, chemistry, and biology. The choice between arts and science at the

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level of secondary education leads to further education and training decisions. There is no need to emphasize the necessity of science subjects in the current technological era but the proportion choosing the science option is only 35%, which is lower than the government estimated target.

The existing research on school students' attitude towards science has been showing a continuous decline of interest in science worldwide (Anderhag et al., 2016; Barmby et al., 2008; Dawson, 2000; Jonathan et al., 2003; Potvin & Hasni, 2014; Simon, 2021). According to students, after primary school, they feel more detached with science and find it more challenging to relate to practical life (Tytler et al., 2008). This negative attitude for science is prominent in the starting of the elementary level of schooling (Kerr & Murphy, 2012; Pell & Jarvis, 2001) or secondary schools (Anderhag et al., 2016; Barmby et al., 2008; Häussler & Hoffmann, 2002; Osborne et al., 2003).

A secondary level of education is a crucial stage of the education system, which is traditionally academic and evaluated by an exam (Olssen & O'Neil, 2004). Students' attitudes toward science are mainly determined by the teachers, students, and the learning environment (Haladyna & Shaughnessy, 1982). Students' feelings and habits (Haste, 2004; Lemke, 2001; Roberts, 2002), teachers related factors such as teaching practices, teacher support, feedback, innovative teaching and learning strategies (Anderhag et al., 2016; Breakwell & Beardsell, 1992; Myers III & Fouts, 1992) and teachers' confidence in teaching science (Tytler et al., 2008) also significantly affect the students' attitude for science learning. Learning environment factors including school, classroom activities, the science curricula, or lab, students' relations with each other determine students' attitude towards science (Myers III & Fouts, 1992; Osborne et al., 2003).

Education is an activity of learning and teaching (Curzon, 2003), so teachers and students need to be involved equally. However, Students' knowledge not only depends on the environment, curriculum, and teacher, but it is also very much dependent on their academic engagement, feeling, and perception about the subject they study. Students' and teachers' attitudes toward science both are equally crucial in a given learning environment. If students' perspectives are negative, they may perform poorly because of lacking interest in science causes difficulties in learning science as it affects the focus of a student in learning. Whereas positive attitudes toward science can build a strong foundation of science (Bae, 2002).

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Some studies have highlighted about gender that boys have positive attitude than girls (Abbas et al., 2011; Weinburgh, 1995) (Beauchamp & Parkinson, 2008; Dawson, 2000; Hill et al., 2010; Jones et al., 2000; Osborne & Simon, 2009; Schibeci, 2008; Weinburgh, 1995). Teachers' confidence in teaching science also leads to effective teaching of science subjects (Tytler et al., 2008). Further cultural, ethnicity, parental, religious have also been found to be critical influences on attitudes toward science (Anderhag et al., 2016; Breakwell & Beardsell, 1992; Christidou, 2006; Dawson, 2000; Khishfe & BouJaoude, 2016; Kidman, 2010; Logan & Skamp, 2008; Lyons, 2006; Osborne et

al., 2003). Few studies have also reported that students' knowledge about science at the primary level and Parental involvement also plays a crucial role in the development of scientific attitudes of students in later years of schooling for science (Abbas et al., 2011; Tytler et al., 2008; Wang & Wildman, 1995). Parents' education, profession, and students' residence influence students' attitudes for science (Anwar & Bhutta, 2014).

A few studies have also verified and found a significant negative correlation between students' anxiety and attitude towards science (Fraser & Fisher, 1982; Kaya & Yildirim, 2014). Students develop science anxiety at a very young age, and girls have been found more prone to science anxiety than boys (Mallow & McDermott, 1988). Previous negative experiences in science classrooms also cause science anxiety among students. Further, the attitudes and beliefs of teachers about science, as well as the method of teaching, can also build students' perception of science (M. Jones, 2006).

Different methods like cooperative learning, the responsive classroom, teachers' support have been found helpful for reducing the level of anxiety among students (Bensoussan, 2012; Griggs et al., 2013; Oludipe & Awokoya, 2010). The use of ICT in students' learning environment has also been considered as an essential factor for students' attitudes (Avgerinou, 2015). ICT as a fundamental component of general education provides opportunities for students to develop important skills like problem-solving, creativity, and collaborating, which are all very important for working 21st-century workplaces (Cisco, 2011). These all skills can be acquired through re-organized educational spaces, new curriculum as well as delivery methods. Thus, the application of innovative ICT facilitate educators in teaching and students in learning (Wilson & Boldeman, 2012).

Studies have shown that ICT makes significant transformations in students' learning, and Students using ICT facilities have higher learning gains. The use of ICT is frequent in the young generation as a source of information, entertainment, and social communication through blogs, wikis, podcasting, and social networking, etc. Although information and communication technologies (ICT) have the power to engage disengaged students (Wilson & Boldeman, 2012). However, there is very little use of ICT in classroom learning.

The education system of Pakistan has several barriers for integrating information and Communication Technologies (ICTs) at the secondary level in Punjab, Pakistan (Hassan & Sajid, 2012; Bhuttah et al., 2020). Abbas et al. (2011) and Shah et al. (2013) showed that in Pakistan, there was an increasing trend in students' attitudes towards science with the change in grade, and girls were more inclined towards science than boys. Students need to be actively engaged in science learning that their positive attitude can be sustained and further enhanced as they grow older (Anwar & Bhutta, 2014).

The substantial effect of ICT integration on the students, teachers, learning environments, and educational policies can improve student learning, through developing ICT competences, academic engagement and thus can lead to higher learning outcomes (Newhouse, 2002). The use of computers and the internet makes students more motivated and attentive in class (Balanskat, 2006). Personal use of technology at home help students to use in school in a better way more recurrently and with more confidence as compared to those students who don't use a computer or internet at home. (Underwood, 2009).

ICT can enhance the students' interests in science learning (Osborne et al., 2003) by reducing the anxiety among students for science subjects. There is a need to emphasize on the infrastructure,

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curriculum up-gradation, and teachers' training for better ICT integration in education at the secondary level (Hassan & Sajid, 2012). Few studies have addressed the importance of ICT as a mediator (Javed et al., 2020); however, the importance of technology between the relationship between students anxiety, students' attitudes towards science among Pakistani students have not been addressed yet.

None of the studies has explained the role of ICT as a mediator between students' attitudes towards science and students' anxiety. This paper fills an identified research gap by providing a mediating role of ICT in science learning for engaging diverse young students in science class at the secondary level. The effect of students' anxiety towards science on students' attitudes has forced to investigate the usage of technology for learning science.

2. METHODOLOGY

The present quantitative study is an effort to assess the mediating role of technology between students' attitudes and anxiety towards science at its best. The data for this study is based on the three questionnaires adopted from different studies.

2.1 THE STUDY POPULATION:

The population of the study is exclusively science students of twenty-five secondary schools in Lahore city of Punjab, Pakistan. Random sampling was done to choose schools as well as students. A total of 350 boys and girls fully completed the questionnaires and returned within two days. All the students were secondary students SSC (SSCI/ SSCII). This study was only focused on science students, so it helped to uncover the general attitude of science students in given anxiety and technological assistance in the Pakistani government educational scenario.

In this study, we used students' attitudes towards science as a dependent, student anxiety as an independent, and students' attitude towards technology as mediators. The mediating analysis in the SPSS21 extension of Preacher and Hayes was done to examine the potential of technology or ICT as a mediator. The following instruments were used in this study:

a) Students' Attitude scale towards science

The data for students' attitudes towards science was measured through Simpson – Troost Attitude Questionnaire (STAQ) (Liaghatdar, Soltani, & Abedi, 2011). This questionnaire has 44 items determining the attitude of science students at the secondary level. Each statement was scaled according to 5-point Likert-type scales (Always, Frequently, Usually, Rarely, and Never).

b) Anxiety towards science scale

The anxiety of students towards science questionnaire was adopted from (Sağir, 2012)'s measure of anxiety. Each item was scaled according to the Likert style questionnaire as strongly agree, agree, I am not sure, disagree, strongly disagree for all 27 questions.

c) Technology attitude scale for learning

Technology attitude scale for learning as a mediator of this study measured the access, perceptions, and learning with technology. The Items 1-11 of the survey are related to the students' access to ICT tools. The access to technological tools was measured through a three-point Likert scale as 1, 2, and 3 for no access, limited access, and full access, respectively. The eight Items as 12-19 measure students' perceptions for learning with Information and Communication Technology on a 5-point Likert scale (1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree). The

students' attitude towards the use of technology for learning was measured through the Items 20-28 on a 5-point Likert scale as well (Chenoby, 2014).

3. RESULTS

3.1 CORRELATION ANALYSIS

For the descriptive statistics and correlation results, Pearson's correlation coefficients were used. Table 1 is showing the correlation between students' attitude, anxiety towards science, and technology attitude for learning. From the results, we can conclude that students' attitudes and anxiety towards science are significantly negatively correlated with each other while significantly positively correlated with technology attitude for learning. Similarly, anxiety towards science is significantly negatively correlated technology attitude for learning.

Table 1: Descriptive statistics and correlations between students attitude, anxiety towards science and technology attitude for learning. (Listwise N=350)

Scales	Mean ± SD	1	2	3
Students' Attitude	131.95±9.32	1	-	-
Anxiety towards Science	90.54±7.51	-.460**	1	-
Technology Attitude for Learning	69.14±6.71	.138**	-.559**	1

*, ** Correlations are significant at the 0.05, 0.01 level (2-tailed), respectively.

3.2 MEDIATION ANALYSIS:

The mediating analysis was conducted with the help of the SPSS21 extension of Preacher and Hayes to capture the mediating part of technology attitude for learning between students' perspectives as dependent and students' anxiety towards science as an independent.

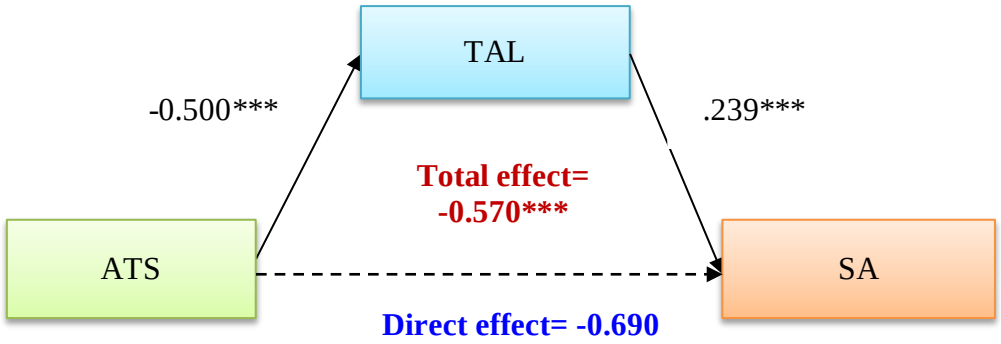

Figure 1: Mediating analysis, Students' attitude as an outcome, Students anxiety towards science as Independent variable and technology Attitude for Learning as Mediator

The result in Figure 1 showed that technology attitude as a mediator for learning mediates the relationship between anxiety towards science (Independent) and students' attitude (Dependent) completely where

TAL = Technology attitude scale for learning

ATS = Anxiety towards science

SA = Students' attitude

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3.3 INDEPENDENT SAMPLES T-TEST

The independent samples t-test tests were used to compare the differences among Students' Attitude, Anxiety towards Science and Technology Attitude for Learning at gender as well as class level.

Table 2: Gender-based differences among students' attitude, anxiety towards science and technology attitude for learning

Variables	Male (n=179)		Female (n=171)		t	p-value
	M	SD	M	SD		
Students' Attitude	133.775	9.88	130.064	8.31	3.796	.000***
Anxiety towards Science	89.551	7.38	91.564	7.53	-2.526	.006**
Technology Attitude for Learning	69.933	5.68	69.326	7.57	2.252	.013*

Table 3: Class-based differences among students' attitude, anxiety towards science and technology attitude for Learning

Variables	9^{th} Class (n=177)		10^{th} class (n=173)		t	p-value
	M	SD	M	SD		
Students' Attitude	130.848	9.77	133.373	8.52	-2.534	.006**
Anxiety towards Science	89.629	7.76	91.712	7.04	-2.595	.005**
Technology Attitude for Learning	69.168	7.15	69.111	6.13	0.242	.469

Tables 2 and 3 depict the results of independent samples t-test tests to compare the differences in the levels of students' attitude, anxiety towards science and technology attitude for learning between gender as well as class. The results show higher levels of students' attitude and technology attitude toward learning in male students as compared to female students. At the same time, anxiety towards science is higher in female students as compared to male students. Similarly, the level of students' attitude and anxiety towards science are significantly higher in the students of class 10th as compared to students of class 9th. In contrast, the technology attitude for learning is not significantly different between students of class 9th and 10th.

4. CONCLUSION

This study was an effort to enhance the interest of students in science by reducing the level of anxiety through technology usage. The level of Students' anxiety related to science subjects can be best understood by asking students. Thus, they can help in identifying what in which ways anxiety can be reduced. To understand it in a better way this study, solely asked students about their attitudes and level of anxiety for science subjects and how much they feel that technology helps them to reduce the level of anxiety towards science.

Besides technology integration in teaching methods and learning environment, science subjects' curriculum is also needed to be more appealing to students, through adding engaging, practical experience. Pakistan has difficulties in the implementation of learning management systems in schools, but also there is no proper access to technology for students in schools. Fortunately, Pakistani students have not yet faced a lack of interest in science as it is happening worldwide, but they suffer from science anxiety.

This study highlights the importance of technology usage in teaching science subjects so that the students' anxiety towards science can be reduced and enhance students' interest in science. This research is an effort to get an insight from students regarding science subjects. The questionnaires helped to get to know about students' attitudes towards science, technology, and anxiety related to science as well. The finding showed that students' attitude towards technology has the potential to completely mediate the relationship between attitude and anxiety in science students. Thus the technology can reduce science anxiety among students, can enhance their engagement in science by making science more interesting and practical.

Pakistan, as a developing country, is not capable of providing technical assistance to every classroom, but with proper management, it can be delivered to every school. In this technological era, we should not ignore the importance of technology-assisted class and teaching methods. Most of the students have access to different technological devices and the Internet outside of school, and they are learning better. There is also a need to find less expensive modes to integrate science subjects with technology. ICT integration policies should be seriously implemented so that Pakistan can achieve the goal set by Millilium development.

5. AVAILABILITY OF DATA AND MATERIAL

Information can be made available by contacting the corresponding author.

6. CONTRIBUTION

In this work, Abdul Sattar Ghaffari and Tariq Mehmood Bhuttah are equal contributors.

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