

**A STUDY OF THE EFFECT OF INTERACTIVE WHITEBOARDS ON
ACHIEVEMENT OF ELEMENTARY SCHOOL SCIENCE STUDENTS**

**Ayesha Sheikh^{1§}, Iftikhar Ahmad Baig¹, Namra Munir¹
Zahida Habib² and Imran Gulzar¹**

¹ Department of Education, The University of Lahore, Lahore, Pakistan

² University of Education, Lahore, Pakistan

[§] Corresponding author Email: brightcareer198@yahoo.com

ABSTRACT

Pressures are mounting on the educational authorities to enhance the use of the technologies in schools to enhance and improve teaching and learning processes. Since last few years, advancements in technological tools and techniques have completely changed learning environment. The research purpose reported in this paper, “A Study of the effect of Interactive Whiteboards on Achievement of Elementary School Science Students” was to analyze and investigate the use of the interactive whiteboards in Science lessons to enhance student learning and scientific concepts.

The research is quantitative in nature. The questionnaire instrument has being adopted to collect the data from the respondents. The research findings have indicated that the importance of interactive white boards in the learning environment such as classrooms cannot be neglected at any instance. The effect of the interactive whiteboards on achievements of science students is positive interlinked.

Index Terms—Educational; Elementary School; Learning; quantitative;

INTRODUCTION

There has being various recent innovations in academic fields in existing age of the information technology. Number of technological devices assist the academic branches to overall operate in high interactive manner as well as they have visualized enriching teaching sessions (Kumar & Promma, 2005). Beginning of technological era has entirely changed educational systems by making learning processes highly memorable for the students, while allowing the teachers to have access to great number of resources (Hung, Huang, & Hwang, 2014).

Academic success is directly related to teach material’s quality. The use of the technological products as teaching assistance might enhance quality and teaching success rates. It can be viewed that integration and production of the technological devices is dynamically increasing day by day. Six years ago, instructors within rural town of Georgia town received interactive whiteboards in the classrooms, with little training in accompanying such new technology (Cano, Reig, Milan-Scheiding, & Lopez-Baeza, 2012). There was great deal of excitement from students and teachers were highly positive but unaware of what these changes would be meaning to existing pedagogical trends.

Students become interested in the daily lesson which is accompanied by instant and real world information and being displayed directly on board. Typical or traditional lessons might have been involved in the traditional textbook curriculum, but such state wide standards and aspects could now be effectively taught through appropriate use of interactive modern media and whiteboards (Kim, et al., 2013). Students could view the importance of science in the daily lives. Existing developments in the research disease, rehabilitation of endangered species and environmental concerns can now be presented in the classrooms by providing real world to the age old standards (Albaaly & Higgins, 2012). Internet provides classroom instructor with up to the date connection between existing discoveries and standards.

With IWB, teacher can appropriately present the real time nature of the technology. When students are absent in schools, they are being deeply ingrained in world where they are being accessed to the high speed global networks, which provides high engagement of multimedia and instant communication. Today, students have great ability to access to enormous quantities of the information technology through the laptops, social networks and mobile phones. Information on demands, collaboration and multi-tasking all acts as a calling card for students. However, entering in the classroom must be a power down.

Existing learning theories deliberately emphasize on the importance of the active engaging children in learning process (Cano, Reig, Milan-Scheiding, & Lopez-Baeza, 2012) and wide range of digitalized technologies, interactive whiteboards have been introduced in schools to enhance active engagement in the learning (Hung, Huang, & Hwang, 2014). Interactive white boards allow the students and teachers to effectively interact with the projected content from the computer screen onto white board's surface. Virtually, anything that is done on the computer can be easily done on interactive whiteboards. The benefit of interactive whiteboards is that interaction with digital content revolves around the manipulation of the information with pens and fingers, resulting in making learning highly interactive through whiteboards, engaging more and more learners and kinesthetic (Hwang, Wu, & Kuo, 2013). Furthermore, marketing, highlighting and drawing of any output of the computer based is highly supported, whole class follows such interactions, and lessons could be saved as well as replayed at any time later when needed.

Interactive white boards allows the users to effectively interact directly with the applications without having any physical contact at computer or laptops which projects image onto board (Zhang, Luo, Huo, & Zhu, 2012). Utilization and adoption of IWB's is dynamically increasing day by day in the education due to its number of benefits as well as innovation it brings to the teaching and learning processes. In number of developing and developed countries, interactive white boards are used in schools and are serving one of the ways of delivering best of the education.

A. Problem Statement

Presences of information and communication technologies have completely changed the way existing learning environments. Now a day's, teachers are highly focused on replacing traditional learning environment to the integration of new and advanced informational technology tools in order to make learning easy, conceptual and productive. One of the most important technological learning tool includes interactive

whiteboards. Interactive whiteboards play a very important role in learning processes and enhance the student's understanding related to the topic. However, due to such its significance, they are not that much integrated or adopted in different educational institutes of Pakistan, especially in the science classrooms. This research work completely revolves around following research problem:

“To analyze and investigate the effect of Interactive Whiteboards on Achievement of Elementary School Science Students”

B. Research Objective & Questions

1. To analyze and investigate the impact of Interactive Whiteboards on achievement of Science Students
2. To highlight the significance of interactive whiteboards in the existing learning environment to enhance student's progress and motivation level

C. Research Question

How does Interactive Whiteboards impacts on the achievement and good performance of Science Students?

LITERATURE REVIEW

Initial research conducted on the appropriate utilization of the interactive whiteboards on higher education, is still exploratory in nature. Most of the research studies (Chen, Chiang, & Lin, 2013) (Luo & Yang, 2016) (Mata, Lazar, & Lazar, 2016) have demonstrated and highlighted that both, students and teachers like interactive white boards technology as it tends to make learning more interesting and engaging. Furthermore, various research studies have analyzed that use of the whiteboards transforms the instruction from the presentation to the interaction and then moves the focus of the student away from the teachers to the content, resulting in making the lessons of interactive whiteboards highly student centered than the traditional ones (Chen, Chiang, & Lin, 2013) (Mata, Lazar, & Lazar, 2016) (Yang, Wang, & Chiu, 2015).

Similarly, there are various data based evidences that reflect that use of the interactive whiteboards could enhance the student achievements. For instance, research work (Yang, Wang, & Chiu, 2015) examined and explored the impacts of the whiteboards lessons on geometry learning of the students in Native America by conducting comparison of the pre to the post test gains of the fifty students who were taught by using interactive whiteboards with the forty students who were not taught by interactive whiteboards. The findings reflected that significant differences in the score gains between the group of interactive whiteboards and control groups was observed. Similarly, research study (Bhardwaj, Soni, & Kotary, 2012) conducted research on the comparison of pre to the post test gains amongst the college classes that were being taught organic chemistry lessons. The groups were categorized into two main categories that included group that were using interactive whiteboards for the learning, whereas the second group did not use interactive whiteboards. Author found significant statistical difference in the gaining scores amongst the student taught through interactive whiteboards, averaging mean of 2.68, whereas control group average mean effective was 2.16.

Two large scale investigation of the impacts of utilizing of the interactive whiteboards on the learning and teaching undertaken in UK. The research findings indicated positive responses of both, teachers and students to use of the interactive whiteboards. The two years research work also focused on investigating the impacts of the use of whiteboard on the student performance by conducting mean progress on the national tests amongst students learning through whiteboards and the students that are not being learned through the white boards. The research showed that a slight positive progress of science students learning through interactive white boards, whereas in the second year, a very good performance and progress of the students was being identified. On the other hand, research findings also showed that in comparison to learning English, interactive whiteboards were very suitable for the scientific students as through interactive whiteboards, through diagrams conceptual learning can be enhanced, completely replacing traditional learning.

In accordance to research (Trainin, Hayden, Wilson, & Erickson, 2016), interactive whiteboards are considered as one of the promising technologies that have high potential of increasing the student achievement. It has led number of United States Schools and the districts to purchase and integrate it in the classrooms in hope that the use will overall improve the students' progress in the standardized tests.

Various research studies (Bhardwaj, Soni, & Kotary, 2012) (Pamuk, Cakir, Ergun, Yilmaz, & Ayas, 2013) (Singh, Rathakrishnan, Sharif, Talin, & Eboy, 2016) were carried to examine and investigate the impact of Interactive whiteboards in learning and teaching processes. The findings reflected that the integration of IWB overall enhances student's motivation and interest towards effective learning making concept clear and easy. It also expands the interaction between the students; meeting wide range of student's needs through the appropriate utilization of multimedia as well as varied presentation of the vast ideas. The research (Kim, et al., 2013) indicated that by using the IWB, students can easily answer number of questions such as "why", "can you explain," that were asked students to overall clarify the mind and assist them to overall enhance their learning. However, complete potential use of the interactive white boards in the learning and teaching process is completely dependent on the way teacher uses it. In most of the researches (Balta & Duran, 2015) (Cheung & Slavin, 2013) (Stout, 2013) it has being found that if the teacher uses IWB's without the consideration of interactivity frames of the IWB's and use it only for the drawing and writing such as similar use of the classical boards, than IIWB will make no such difference in the teaching and learning process. Learners, researchers and teachers, can only benefit from the research on utilization of IWB's that will install to almost every governmental school.

RESEARCH METHODOLOGY

Research is always surrounded by number of critical and complex challenges which can overall be overcome by the utilization of right or best fit research methodology (Martinez, Basford, De Jager, & Hart, 2012). There are various sorts of research approaches which have been presented to achieve the required target or objective such as (Cano, Reig, Milan-Scheiding, & Lopez-Baeza, 2012; Bhardwaj, Soni, & Kotary, 2012).

Research methodology ensures that if the specific path or phases are followed the required goal can be achieved. It has been analyzed from the existing researches (Zhang, Luo, Huo, & Zhu, 2012; Kim, et al., 2013) that most of the scientific evidence has been provide that overall success of the research is high depend upon the selection of right methodology or research design. The aim of the present study was to explore the effectiveness of the Interactive Whiteboard (IWB) on students' achievement score (SAS) at the elementary level in the subject of Science.

In this chapter, we have identified and analyzed the research design for investigation of the effect of Interactive Whiteboards on Achievement of Elementary School Science Students. There is a high probability that the selection of right research methodology will help us to achieve the required goal. In the next section, we have presented the research design for the identification and analyzing of the effect of Interactive Whiteboards on Achievement of Elementary School Science Students.

A. Research Design

Research design is one of core component of research on which the whole concept of the system is simulated so that required task and activity can be performance (Rauf, 2015; Martinez, Basford, De Jager, & Hart, 2012). There are various sort of research methodology which can be utilized in the context of the existing research study. However, in the research we have utilized the (Rauf, 2015) methodology which has been design and developed for performing scientific researches and researches that involved various sort of experimental and statistical analyses.

B. Research Approaches

Research Approaches foundation is based on the two main categories which are defined as deductive and inductive approach and these approaches can be adopted for the quantitative and qualitative research methods (Kumar & Promma, 2005).

In this sub section of proposed we have presented a detail discussion on the research design which has been adopted from (Rauf, 2015). One of the main justification which has been conducted for selecting the research methodology of (Rauf, 2015) for identification and analysis of the impact of Interactive Whiteboards on Achievement of Elementary School Science Students is that the similar methodology has been utilized in various researches which has been conducted within the context of advance technology and their applications (Kumar & Promma, 2005; Singhal, Gankotiya, Agarwal, & Verma, 2012).

In this research, we have adopted the design of (Rauf, 2015) has been divided into eight main phases and these phases are connected with each other. The feed forward and feed backwards techniques has also been utilized so that in case of any error or if the required result is not achieved the research can move back to the previous stage.

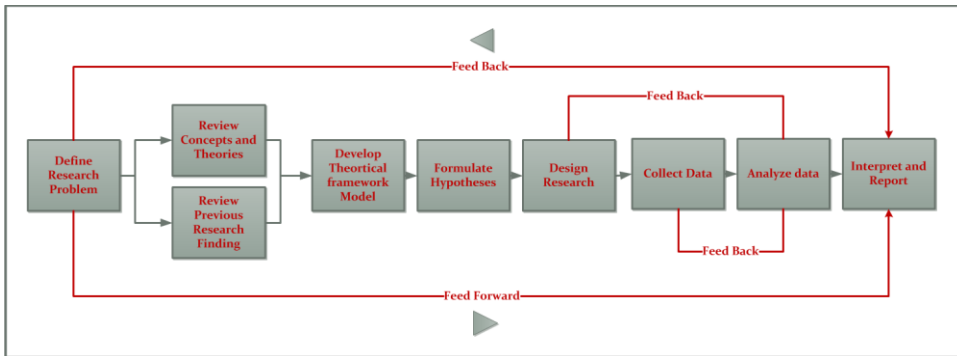


Fig. 1: Research Methodology (Rauf, 2015)

In the Table 1 Research Steps, we have identified and analyzed the research methodology and the steps that will help us to ensure that if followed correctly the required results within the context of impact of interactive white boards on student's Achievement.

**Table 1
Research Steps**

Phases	Phase Name	Sub Phase	Description	Feedback Technique
Phase I	Define Research Problem	Developing the Problem statement	This is the initial phase of the research design in which the research problem has been defined, which is presented as followed: <i>“To analyse and investigate the effect of Interactive Whiteboards on Achievement of Elementary School Science Students”</i>	Feed Forward Technique is integrated, Feedback technique is integrated
Phase II	Existing Literature	Review concept and Theory Review previous research finding	As the problem statement is defined so now the next task is to identify and analyse that what the current researches which has been conducted within the context of interactive white boards and their association with the student's achievements.	

Phases	Phase Name	Sub Phase	Description	Feedback Technique
Phase III	Develop Theoretical Framework	Development of the framework based on the parameters which has been extracted from Existing Literature	As mentioned before there are various researches which has been conducted within the context of interactive white boards and student's achievements. However, in this phase we will be analysing the dependent and independent variables.	
Phase V	Design Research	Sampling, Population Subject Selection	In this phase the overall research design for the data collection and analysis will be developed. In this research we will be utilizing the secondary and primary data.	Feed Forward Technique is integrated,
Phase VI	Collect Data	Primary Sources Secondary Sources	The collection of data will be conducted through secondary data and primary data. There are various research paper and articles which we have being considered in this research. However, we will only be analysing the researches which has been conducted in the past five years within the interactive white boards and student's achievements. Similarly, we have being considering questionnaire technique to collect data.	Feed Forward Technique is integrated,
Phase VII	Analyse Data		This is the second last phase of the research methodology. In this phase the detailed analysis of the existing solution presented for the existing research. The graph will be developed so that overall the results and performance of the system can be analysed.	Feed Forward Technique is integrated,

Phases	Phase Name	Sub Phase	Description	Feedback Technique
Phase VIII	Interpret and Report		In this phase, all the information will document in a systemic ways so that the research analysis and results can be future analysed. This is a time consuming process and there is a high probability that research may need to move back to previous stage if the required results are not achieved.	

C. Subject Selection

Subject selection is dependent upon various parameters which need to be measure and identify in order to provide the solution to address the problem identified in interactive white boards and student achievement. There are various subject will need to be analyzed in order to provide the solution.

D. Procedure

The research is quantitative in nature, thus the complete focus was laid on the utilizing and adopting questionnaire research instruments to collect the data from the respondents. The procedure of the research has being comprised of various phases. In the first phase, the schools from where the data needs to be collected was considered and identified. Bright Career School System Model Town Gujranwala branches that is boys branch, and girls branch had being selected as the interactive white board facility has being. From the boys branch, 49 boys have being considered, whereas from the girls branch, 98 girls have being considered. Total number of students was 147 from both of the Bright Career School System Model Town Gujranwala branches.

Four different classes were selected and after teaching for the four weeks, their results and outcomes were collected in form of the questionnaire. The questionnaires were processed and data analysis was done.

DATA ANALYSIS AND PRESENTATION

TData analysis and presentation plays a dynamic role for the conduction of the research study. In this chapter, first part is explaining the demographic information related to the students, covering their important aspects such as age, gender, class and Bright Career School System Model Town Gujranwala branches. In the second part is about the correlation analysis shows the relationship between the independent variable, dependent variable and testing of the hypotheses. Regression analysis is also the statistical tool in which the researcher analyse the model variances. And in the end Chi model test is denoted by χ^2 test, it is also a statistical tool for the testing of the null hypotheses and applies on the sampling distribution technique. The related information is

as follow:

A. Demography Analysis

The role of the demographic analysis is very important related to the research study the effect of Interactive Whiteboards on Achievement of Elementary School Science Students. Some of the related demographic information is as follow:

i) Age

The demographic age is plays a significant role for the conduction of research study. According to the data age factor is further divided into various ages such as 13 year i-e 12.9%, 14 years i-e 42.2%, 15 years i-e 36.1%, and 16 years i-e 8.8%. The results shows that the contribution for the conduction of this research study student are 14 years as compared to other ages.

Table 2
Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	13 year	19	12.9	12.9	12.9
	14 years	62	42.2	42.2	55.1
	15 years	53	36.1	36.1	91.2
	16 years	13	8.8	8.8	100.0
	Total	147	100.0	100.0	

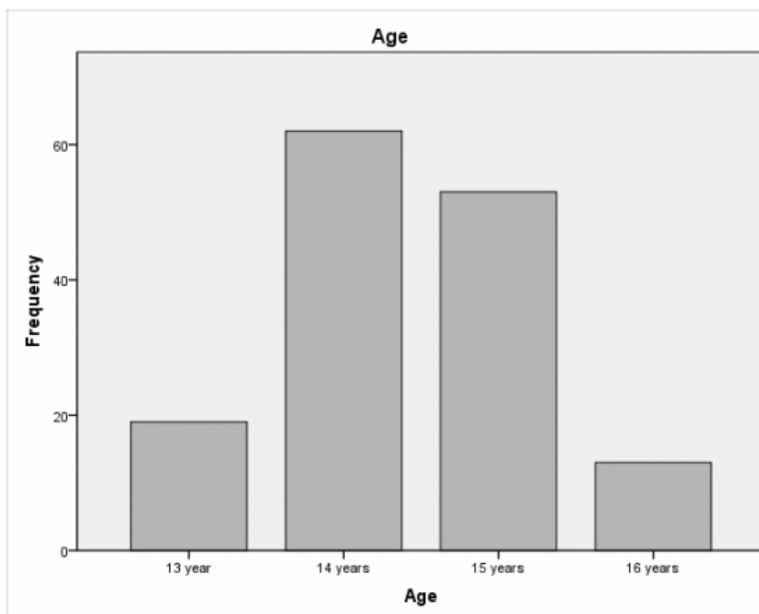


Fig. 2: Age

ii) Gender

The gender table included the demographic information collected from the males and females. According to the research study the percentage of the males are 33.3, and females are 66.7, out of 100% from the Bright Career School System Model Town Gujranwala. These respondents are taken from both branches of Bright Career School System Model Town Gujranwala that is boys branch and girls branch, Total number of participant is 147 help for the conduction of the research study.

Table 3
Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	49	33.3	33.3	33.3
	Female	98	66.7	66.7	100.0
	Total	147	100.0	100.0	

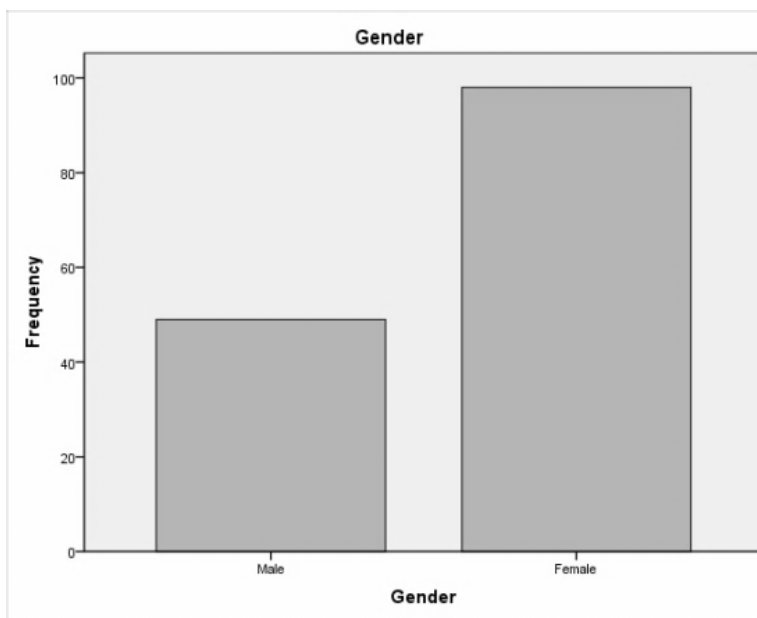


Fig. 3: Gender

iii) Class

In this class table is related to the participant of the students for the conduction of the research. According to the data 7th class contributed 51%, 8th class contributed 22.4%, 9th class contributed 9.5% and 10th class contributed 17.0% for the conduction of the study.

Table 4
Class

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	7th Class	75	51.0	51.0	51.0
	8th Class	33	22.4	22.4	73.5
	9th Class	14	9.5	9.5	83.0
	10th Class	25	17.0	17.0	100.0
	Total	147	100.0	100.0	

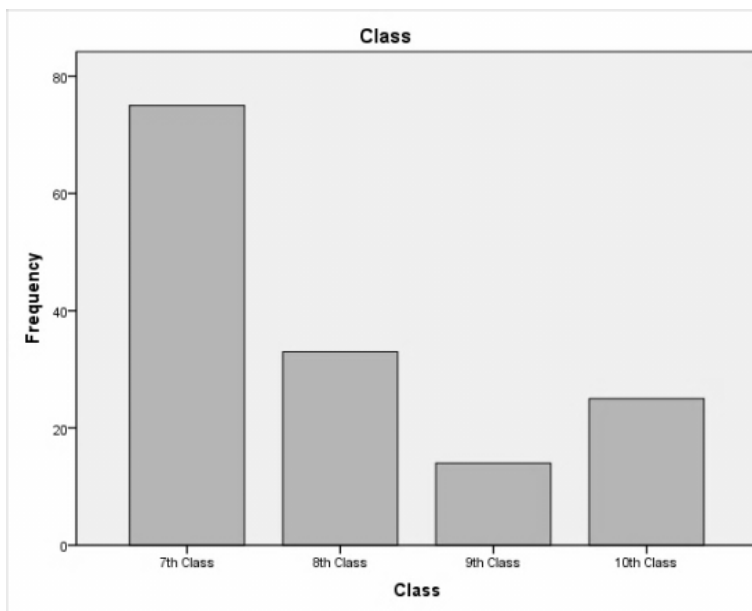


Fig. 4: Class

B. Pearson Correlations

Pearson correlation table is used to find the relationship between the variables. Correlation analyses mostly researchers used for the testing of the hypotheses. According to the research data it is analysed that there are four main hypotheses are derived from theoretical framework model. Hypothesis one is about the “Interactive White Boards is positively associated with the teaching and learning”. Its correlation coefficient values shows that .228**, at the level of sig =.000, sample size is denoted by N =147. Second hypothesis is about the interest of the learners is positively associated with the teaching and learning. Its correlation coefficient .291**, sig level =.000, Third hypothesis is about the concepts of the learners is positively associated with teaching and learning. It correlation coefficient values shows that .710**, sig level =.000, Forth hypothesis is about the thinking of the learner is positively associated with the teaching and learning. Its correlation coefficient .289*, sig level= .000. Hence all the hypotheses are proved.

Table 5
Correlations

		Interactive White Boards	Interest of the Learners	Concepts of the Learners	Thinking of the Learners	Teaching and Learning
Interactive White Boards	Pearson Correlation	1	.247**	.265**	.186*	.228**
	Sig. (2-tailed)		.000	.000	.000	.000
	N	147	147	147	147	147
Interest of the learners	Pearson Correlation	.247**	1	.455**	.459**	.291**
	Sig. (2-tailed)	.000		.000	.000	.000
	N	147	147	147	147	147
Concepts of the learners	Pearson Correlation	.265**	.455**	1	.334**	.710**
	Sig. (2-tailed)	.000	.000		.000	.000
	N	147	147	147	147	147
Thinking of the learners	Pearson Correlation	.186*	.459**	.334**	1	.289**
	Sig. (2-tailed)	.000	.000	.000		.000
	N	147	147	147	147	147
Teaching and learning	Pearson Correlation	.228**	.291**	.710**	.289**	1
	Sig. (2-tailed)	.000	.000	.000	.000	
	N	147	147	147	147	147

C. Regression

Table 6
Variables Entered

Variables Entered/Removed^b			
Model	Variables Entered	Variables Removed	Method
1	Thinking of the learners, Interactive White Boards, Concepts of the learners, Interest of the learners	.	Enter
a. All requested variables entered.			
b. Dependent Variable: Teaching and learning			

Table 7
Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.716 ^a	.513	.499	2.56896
a. Predictors: (Constant), Thinking of the learners, Interactive White Boards, Concepts of the learners, Interest of the learners				

In this model summary table, regression is denoted by $R = .716$, R square = .513 and adjusted R square = .499. The main predictors are thinking of the learners, Interactive White Boards, concepts of the learners, and interest of the learners. All of these values are in the favour of the study.

Table 8
ANOVA

ANOVA ^b						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	986.900	4	246.725	37.385	.000 ^a
	Residual	937.134	142	6.600		
	Total	1924.034	146			
a. Predictors: (Constant), Thinking of the learners, Interactive White Boards, Concepts of the learners, Interest of the learners						
b. Dependent Variable: Teaching and learning						

In this ANOVA table, the values of the regression i-e 986.900, degree of freedom $df = 4$, and frequency is denoted by $F = 37.385$ shows the variance in the model at the sig level =.000.

Table 9
Coefficients

	Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.338	1.038		-.326	.000
	Interactive White Boards	.066	.090	.045	.736	.000
	Interest of the learners	-.117	.105	-.079	-1.110	.009
	Concepts of the learners	1.369	.131	.707	10.472	.000
	Thinking of the learners	.208	.173	.080	1.202	.001
a. Dependent Variable: Teaching and learning						

Coefficient table is divided into two main components such as unstandardized coefficient and the other one is standardized coefficient. Here, in this table, the values of the Beta show the best predictor interest of the learners such as (.079). Second best predictor is the thinking of the learners the value of the Beta .080. All of these values are in the favor of the study

CONCLUSION

The purpose of the research was to analyze and investigate the use of the interactive whiteboards in Science lessons to enhance student learning and scientific concepts. The research question examined was: How does Interactive Whiteboards impacts on the achievement and good performance of Science Students?

It has being concluded that the importance of interactive white boards in the learning environment such as classrooms cannot be neglected at any instance. It is considered that

most of the teachers are focused on the memorized and rote learning, which, to some extent, is not considered to be a productive learning as it is only for the time being, student forgets after exam or test. This is not considered to be a positive learning. It has been considered that interactive white boards provide new aspect to the learning making learning not only interesting but also easy. Interactive white boards have been utilized by number of schools in developed countries; however, their integration in Pakistan is very low. Similarly, during the research surveys, it has been analyzed that teachers have been only focused on the traditional learning and should be replaced by the integration of new and innovative technological tools.

Interactive white boards make learning interesting and motivate the students to learn. These two elements are considered to be highly important and play a very significant role in the learning. For instance, if the learner considers anything interesting, he or she, will not be forgetting it and this overall makes learning easy. Similarly, in context of Science topics, they completely revolve around figures, different diagrams, charts, and tables. It has been considered that if they are presented in very effective way, they make the concept clearer as well as easier. The findings of research has reflected that interactive white boards bears significant importance in the learning environment especially in the science subjects and it should be integrated in more and more schools.

RECOMMENDATION

Some of the recommendations based on data analysis are presented as followed:

1. Educational institutes in Pakistan, especially schools should adopt the use of interactive white boards in the learning and teaching process, and it is recommended that teacher's should be appropriately trained of how to use such technology. It has been considered that most of teachers are reluctant to use innovative and new technology due to numerous factors such as general fail of failing to use technology during lesson, lack of the professional development and small preparation time. It is suggested that good training and development of the teachers or instructors to adopt such technology would be highly advantageous.
2. Teachers must take various cautions, that over time, they need to reflect on the existing teaching practices to ensure that technology is being effectively used and that students are being benefited rather than being suffering from the use. Similarly, administration that is being responsible for implementation of the new technology should be highly cognizant of both, enhancements and various pitfalls that the technology might present to the pedagogic intent. It has been recommended that BIM application must be simulated on the cloud computing architecture so that resource limitation issue can be resolved.

REFERENCES

1. Kumar, S. and Phrommathed, P. (2005). *Research methodology* (pp. 43-50). Springer US.
2. Hung, C.M., Huang, I. and Hwang, G.J. (2014). Effects of digital game-based learning on students' self-efficacy, motivation, anxiety, and achievements in learning mathematics. *Journal of Computers in Education*, 1(2-3), 151-166.

3. Cano, A., Añón, J.L., Reig, C., Millán-Scheiding, C. and López-Baeza, E. (2012). Automated soil moisture monitoring wireless sensor network for long-term Cal/Val applications. *Wireless Sensor Network*, 4(8), 202-209.
4. Kim, J.T., Ho, D.D., Nguyen, K.D., Hong, D.S., Shin, S.W., Yun, C.B. and Shinozuka, M. (2013). System identification of a cable-stayed bridge using vibration responses measured by a wireless sensor network. *Smart Struct. Syst.*, 11(5), 533-553.
5. Albaaly, E. and Higgins, S. (2012). The impact of interactive whiteboard technology on medical students' achievement in ESL essay writing: an early study in Egypt. *The Language Learning Journal*, 40(2), 207-222.
6. Hwang, G.J., Wu, C.H. and Fan-Ray, K. (2013). Effects of touch technology-based concept mapping on students' learning attitudes and perceptions. *Journal of Educational Technology & Society*, 16(3), 274-285.
7. Zhang, Y., Luo, L., Huo, J. and Zhu, W. (2012). An eco-hydrology wireless sensor demonstration network in high-altitude and alpine environment in the Heihe River Basin of China. *Wireless Sensor Network*, 4(05), 138-146.
8. Chen, H.R., Chiang, C.H. and Lin, W.S. (2013). Learning effects of interactive whiteboard pedagogy for students in Taiwan from the perspective of multiple intelligences. *Journal of Educational Computing Research*, 49(2), 173-187.
9. Luo, Y.F. and Yang, S.C. (2016). The Effect of the Interactive Functions of Whiteboards on Elementary Students' Learning. *Journal of Educational Computing Research*, 54(5), 680-700.
10. Mata, L., Lazar, G. and Lazar, I. (2016). Effects of study levels on students' attitudes towards interactive whiteboards in higher education. *Computers in Human Behavior*, 54, 278-289.
11. Yang, K.T., Wang, T.H. and Chiu, M.H. (2015). Study the Effectiveness of Technology-Enhanced Interactive Teaching Environment on Student Learning of Junior High School Biology. *Eurasia Journal of Mathematics, Science & Technology Education*, 11(2), 263-275.
12. Bhardwaj, M., Soni, S. and Kotary, D.K. (2012). Comparative analysis of energy efficient routing protocol for wireless sensor network, *International Journal of Computer Applications, Special Issue on Wireless Communication and Mobile Networks* 1, 65-59.
13. Trainin, G., Hayden, H.E., Wilson, K. and Erickson, J. (2016). Examining the Impact of QuickReads' Technology and Print Formats on Fluency, Comprehension, and Vocabulary Development for Elementary Students. *Journal of Research on Educational Effectiveness*, 9(sup1), 93-116.
14. Pamuk, S., Cakir, R., Ergun, M., Yilmaz, H.B. and Ayas, C. (2013). The use of tablet PC and interactive board from the perspectives of teachers and students: Evaluation of the FATİH Project. *Educational Sciences: Theory and Practice*, 13(3), 1815-1822.
15. Singh, S.S.B., Rathakrishnan, B., Sharif, S., Talin, R. and Ebov, O.V. (2016). The Effects of Geography Information System (GIS) Based Teaching on Underachieving Students' Mastery Goal and Achievement. *TOJET: The Turkish Online Journal of Educational Technology*, 15(4), 119-134.
16. Balta, N. and Duran, M. (2015). Attitudes of students and teachers towards the use of interactive whiteboards in elementary and secondary school classrooms. *TOJET: The Turkish Online Journal of Educational Technology*, 14(2), 15-21.

17. Cheung, A.C. and Slavin, R.E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta-analysis. *Educational Research Review*, 9, 88-113.
18. Stout, L.L. (2013). A Comparison Group Study of Teaching with the Interactive Whiteboard and its Impact on Student Achievement Outcomes for Grade 5 Students of Economic Disadvantage. *ProQuest LLC*, Dallas Baptist University.
19. Martinez, K., Basford, P.J., De Jager, D. and Hart, J.K. (2012). A wireless sensor network system deployment for detecting stick slip motion in glaciers. In *IET Conference on Wireless Sensor Systems (WSS 2012)*, 1-3.
20. Rauf, W. (2015). Role of Computing Organizational Justice in Reducing the Conflict between the Employees and Its Impact on the Job Performance. *Journal of Information Technology and Management Sciences*, 54(60), 54-60.
21. Singhal, S., Gankotiya, A.K., Agarwal, S. and Verma, T. (2012). An investigation of wireless sensor network: A distributed approach in smart environment. In *IEEE 2012 Second International Conference on Advanced Computing & Communication Technologies (ACCT)*, 522-529.