Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

EFFECT OF ICT BASED TEACHING ON STUDENTS' PERFORMANCE

MUHAMMAD SAIF UR REHMAN

Ph.D Education, Scholar, The University of Haripur, KP, Pakistan.

ASAF NIWAZ

Associate Professor, (Supervisor), The University of Haripur, KP, Pakistan.

Abstract

In developing countries like Pakistan, teachers are not trained and equipped in utilizing latest technologies in their teaching. In Pakistan, the use of Information and communication technologies (ICT) in schools is limited in schools. The purpose of this study was to find out the effect of ICT based teaching on students' performance in the subject of physics. The true-experimental and Solomon four equivalent group design was used in the current study. The population of research consist of the students (boys & Girls) enrolled in the 9th grade studying physics in public schools. The sample comprised of male (N = 40) experimental and control each and female (N = 40) experimental and control each. The self-developed physics achievement test (PhAT) was used having 100 MCQs. It was further validated and made reliable (α = 0.836). The experimental groups were taught through the use of ICT for 3 months. The results showed that experimental group outperformed as compared to control group. But there was no significant difference found between the participants who received pre-test with the participants who have not received pre-test. Therefore, it was recommended that teachers may use ICT tools for teaching physics.

Keywords: Science, ICT teaching, academic achievement, Students

INTRODUCTION

Implementing the current curriculum without taking the evolving conditions into consideration can only provide the same outcomes as in the past, as the various elements of education have been changing continuously in recent years. Information and communication technology (ICT) has been one of the key factors in raising educational standards. Therefore, it is crucial to teach teachers how to utilise ICT efficiently. In addition to the fact that ICT has advanced and technology is now used in educational settings, it has become vital for societies to follow revolutionary technology in order to self-adapt (Çelik & Gundogdu, 2016).

Achievement in curricular activities depicts about a student how well a he/ she has learnt in relation to achieving the desired objectives, which are the main focus during the whole academic year by the institutions. The objectives that a student achieves may target the cognitive goals, which may be either general or specific in nature to represent a person's achievement. Further, these goals achieved by the students through gaining information and perform intellectual activities in educational institutions. These activities may be related to maths, science or language. Fulfilling the learning objectives encompasses wide range of educational outcomes and they have very broad scope. The students' success depends upon their results, which they gain by achieving scores in terms of grade point average (GPA) or by standardised tests. These tests decides whether a particular student will have a chance continue their education (e.g., to attend a school) (Steinmayr et al., 2018).

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

LITERATURE REVIEW

Mark (2017) argued that ICT deals with technologies that are used to move information (process data) from one device (computer) to another. Computers, audio-visual equipment, multimedia software, the internet, modem, fax machines, and animation software are some of these technologies. Computers are utilised in the teaching of fundamental skills. Through drills, tutorials, and the use of a particular computer adaptor for the deaf, computer assisted instruction (CAI) enables students to study at their own speed. Spread sheets created using word processing are used to help manage student grades in worksheets. ICT usage in education has grown quickly. As a result, there is e-learning in the classroom and more students are learning online. Currently, online courses from distant institutions are available.

According to Phakkdey (2016), an increasing number of teachers are using computer graphics, video discs, CD-ROMS, and other digital media to present material to children in a more engaging way. While others guide students using animation and AutoCAD, other instructors design in-class Power Point presentations utilising computers and multimedia technologies. Many educators employ hypermedia and interactive multimedia tools to engage their pupils more in the learning process than they would with traditional, teacher-controlled media presentations, which are viewed as passive.

Since the 1980s, there have been believes that ICT will transform education (Cuban, 2001). However, from a policy perspective, these expectations frequently appear to be exaggerated (OECD, 2015), and they are frequently contested by academics from around the globe (such as Lindqvist, 2015). Olofsson et al. (2015) maintain in their review of the literature that small case studies may need to go beyond the current needs for educational research and there may be successful implementation of curricular and co-curricular activities because the adoption of ICT and its usage at secondary or upper levels must be understood by educator and successfully implemented from a variety of different perspectives, both in theory and in practice.

Sipila (2014) stated that teacher use ICT-based teaching and learning tools, which are influenced by their level of digital competence. Male and Burden (2014) contend that pupils' ability to understand how ICT might be used for learning in educational contexts is influenced by their level of digital competence. A third hypothesis is that students' use of ICT outside of the classroom may have an impact on how they perceive how ICT is applied to instruction in the classroom (Kolikant, 2012). However, only a small number of researches target the same contexts and conditions and concentrate on how teachers and students interpret and use ICT (Ingleby, 2014).

Ali et al. (2013) proposed that there are various factors that may influence the effective use of ICT in classroom. These factors included teachers' educational and professional background regarding ICT, experience in using such tools, provision of technical support from administration, successful implementation of government policies, pressure to use ICT, students as well as teachers' accessibility towards ICT tools, school leadership support and technological characteristics.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

Several researchers have looked into ICT-based education in schools. Ben Youssef et al. (2022) investigated ICT-based digital literacy and gap towards digital platform and its effectiveness on students' achievement. A questionnaire was administered on 1323 respondents enrolled in French schools. The data collected and analysed using factorial analysis and logistic regression based on objectives. There were four conclusions drawn from the results. It was found that inadequate provision of investment in ICT sector has made negative impact on students' performance. Secondly, the training provided to students on the use of ICT tools has little bearing on their results. Thirdly, the use of ICT in an innovative and collaborative way has produce positive impact on students' results. Lastly, obtaining digital skills also made positive effect on students achievement in schools.

A case study on the use of ICT in teaching Physics conducted by Livingstone (2015) indicated that ICT was mostly utilised during the preparation portion of the session, particularly when typing up lesson plans and schemes of work. He mentioned that teachers assess student test results on computers as well. Despite the fact that the majority of the physics instructors in the tested schools had had computer training, ICT utilisation during course delivery was rather low. He pointed out that if ICT is employed in lesson design, course delivery, and evaluation, both instructors and students would profit.

Basri et al. (2018) researched on acceptance of ICT based curriculum by tertiary education and its impact on students' performance. This study incorporated socio-economic status of students and GPA. The association between ICT influence on students and academic success also investigated in this study. The quantitative study and survey design adopted for four Saudi institutions. The questionnaire was administered to 1000 sampled students using simple random technique. The validity and reliability of instrument examined using structure equation modelling (SEM). The Analysis of Moment Structures (AMOS) used for the analysis procedure. After analysing, the findings showed that there is a strong association found between use of ICT and academic achievement. It also improved female students' performance than male.

Ishaq et al. (2020) made an effort to catalogue the many impacts of ICT on tertiary education. Researchers in Pakistan looked into the connection between students' usage of ICT and their academic success in both public and private universities. The study was conducted using a questionnaire and 300 students. The Pearson correlation coefficient and descriptive statistics were used to determine the rate and determine whether there is any relationship between ICT and students' academic performance. The findings revealed that the majority of students owned laptops and personal computers, and they had access to the Internet in institutions. Many students claimed they utilised ICTs to enhance their fundamental abilities and engage actively in their studies. Additionally, it is well-established that effective ICT use, which has substantial effects on students.

Many of the researches as cited above investigated various aspects of ICT in education. They explored its effects on academic achievement of students. These aspects were investigated at tertiary level. Many scholars examined academic achievement of students using experimental method. The international, regional and national researches on ICT based teaching focused on limited aspects of learning and ICT based tools for teaching

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

and learning process. Moreover, no research has been conducted at secondary level in subject of physics. As a result, the researcher decided to investigate the impact of ICT based teaching on students' academic achievement in physics. This study had following research hypotheses to check;

H_A1: The students who take the pre-test and receive the ICT based teaching will score higher on academic achievement in learning physics in the post-test than the students who take pre-test and receive conventional teaching in the post-test.

H_A2: The students who take receive the ICT based teaching without pre-test will score higher on academic achievement in learning physics in the post-test than the students who take conventional teaching in the post-test without pre-test.

H_A3: The students who take the pre-test and receive the ICT based teaching will score higher on academic achievement in learning physics in the post-test than the students who do not take pre-test and receive ICT based teaching in the post-test.

$H_0 4$: The students who take the pre-test and receive the lecture method will not score higher on academic achievement in learning physics in the post-test than the students who do not take pre-test and receive lecture method in the post-test.

RESEARCH DESIGN

The true-experimental and Solomon four equivalent group design was used in the current study. The researcher selected two schools for male and two for female students. First male and female school students have two groups; control and experimental who received pre-test before treatment. The second school was selected by researcher for both male and female students who also have two groups respectively; control and experimental groups and have received only post-test. The selection of students was equivalent for both male and female. The experimental group received the treatment of ICT based teaching while control group received conventional teaching method for three months period. The hired/ volunteer teachers who implemented intervention were given the first week orientation to device the design in class accordingly. Prior to the application, extensive planning for both groups were prepared and processing the same content for both groups which was taken into consideration.

Table 1: Solomon four group design

Test	Pre-test	Treatment	Post-test
a) R	O1	X	O2
b) R	O3		O4
c) R		X	O5
d) R			O6

Population

The population of research consist of the students (boys & Girls) enrolled in the 9th grade studying physics in public schools.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

Sample and Sampling Technique

The sample of the study comprised of male (n = 40) for experimental and (n = 40) for control groups in GHSS (Male) Sarai-Saleh and GHS No. 2 Haripur. In addition, female sample size also comprised of (n = 40) for experimental and (n = 40) for control groups in GGHSS (female) Sarai-Saleh and GGHS No. 2 Haripur. Simple random sampling applied to choose the sample. Students of four schools were targeted to collect the data. Pre-test conducted at GHS and GGHS No. 2 Haripur. In addition, GHSS and GGHSS Sarai-Saleh without pre-test selected with equal participants. The following instruments devised in the current research.

Physics Achievement Test (PhAT)

The PhAT comprised of 100 MCQs from the textbook of physics from grade 9^{th}. The MCQs were developed by the researcher from the book. The following first five chapters from textbook were selected for the experiment. Therefore, these chapters were used to make PhAT. The 20 MCQs from each chapter were established. (i) Physical quantities and measurement, (ii) Kinematics, (iii) Dynamics, (iv) Turning effect of Forces, and (v) Gravitation.

These chapters were the part of experiment. The MCQs were developed with four possible distractors. Each MCQ was given one point for correct response. The 120 minutes were given to students to complete the MCQs test in both pre and post-tests. This tool was used for male and female students in pre-test, post-test.

Content validity of PhAT was determined by expert judgements. A panel of five experienced Physics teachers teaching to secondary school classes validated the test. Errors were identified by the panel and suggestions were given by each expert. The mistakes were rectified afterwards and suggestions were incorporated. Afterwards, the PhAT was pilot tested among 40 students from GHSS No. 1 Haripur. The PhAT was distributed among students and researcher clears the instructions among the students for clarification. The 120 minutes were given to students for completion. After administering the PhAT, the data entered in Excel based on correct response for each item 1 and 0 recorded for wrong response of 40 students. The data analysed in SPSS and split half test was used for PhAT. So, the reliability coefficient of PhAT was (0.836) which is satisfactory and to be utilized in actual procedure.

Procedure

The electronic smart board as well as computer labs and other useful electronic resources were used in teaching physics as intervention for consecutive three months. The volunteer teachers, who were given the orientation, taught physics through smart board and other electronic devices to experimental groups of male and female while control group was taught by the teachers with similar qualification, experience through traditional method. Before the start of experiment, the targeted group received pre-test. The intervention procedure was started for other two groups without pre-test. The researcher monitored daily performance of each group during experimentation. Afterwards, a post-

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

test was administered to all four groups of students as described in figurative research design above.

Data was collected through pre-test PhAT from students during pre and post-tests. The data entered in Excel and SPSS at the end. Afterwards, the data analysed in the light of research hypotheses. The two-way ANOVA (Factorial design) used as proposed by the Solomon research design. The study exhibited two independent variables with two levels of each i.e. (Pre and No Pre-test) and (treatment and control group). These two variables evaluated on dependent variable with single level i.e. PhAT of students.

Table 2: Descriptive statistics of students with pre and without pre-tests

Groups	N	Treatment	Mean	SD
Participants with Pre-Test	80	ICT Intervention	41.0750	8.62991
	80	Lecture Method	33.6750	10.71232
	160	Total	37.3750	10.38247
Participants without Pre-Test	80	ICT Intervention	40.2625	8.72468
	80	Lecture Method	32.6750	9.85820
	160	Total	36.4687	10.02947
Total	160	ICT Intervention	40.6688	8.65969
	160	Lecture Method	33.1750	10.27395
	320	Total	36.9219	10.20158

The table 2 depicted the descriptive statistics of students' scores in which participants to took pre-test and ICT intervention (M = 41.07, SD = 8.62) and lecture method (M = 33.67, SD = 10.71). In addition, participants without pre-test and received ICT intervention (M = 40.26, SD = 8.72) and lecture method (M = 32.67, SD = 9.85).

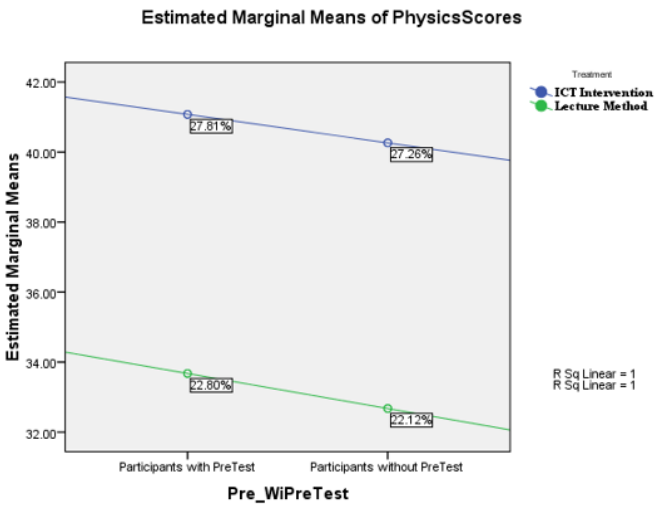
Table 3: *Test of between-subjects effects on PhAT*

Source	Type III Sum of Squares	*df*	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	4558.909[a]	3	1519.636	16.767	.000	.137
Intercept	436231.953	1	436231.953	4.813E3	.000	.938
Pre & No Pre-test (1)	65.703	1	65.703	.725	.395	.002
Intervention Group (2)	4492.503	1	4492.503	49.568	.000	.136
Within Interaction (1x2)	.703	1	.703	.008	.930	.000
Error	28640.138	316	90.633			
Total	469431.000	320				
Corrected Total	33199.047	319				
a. R Squared = .137 (Adjusted R Squared = .129)						
b. Computed using alpha = .05						

A two-way analysis of variance was conducted of two independent variables (Pre and No Pre-test). It included two levels and intervention group (treatment and control group). All effects were found non-significant $p > .05$ except for intervention. The main effect for intervention yielded an F (1, 316) = 49.568, $p < .05$, with partial effect size η_p^2 = .136) indicating a significant difference between experimental (M = 40.6688, SD = 8.65969) and control group (M = 33.1750, SD = 10.27395). The main effect for pre and no pre-test

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

group produced an F (1, 316) = 0.725, $p > 0.05$, with zero effect size η_p^2 = .002) showing non-significant difference between participants with pre-test (M = 37.3750, SD = 10.38247) and participants without pre-test (M = 36.4687, SD = 10.02947). Moreover, the main effect for within interaction (1x2) indicated an F (1, 316) = 0.008, $p > 0.05$, with zero effect size η_p^2 = 0.000).



The figure showed there is no significant interaction found between the participants who received pre-test with the participants who have not received pre-test. But there is significant difference can be seen between ICT intervention and lecture method.

DISCUSSION

The study highlighted the effect of ICT based teaching on students' performance in physics subject of 9th grade students. The results indicated that there is significant difference between experimental and control group. The experimental group have shown better performance in post-test after three months of intervention. The similar results can be seen in Ishaq et al. (2020) study who examined the resources of ICT used by students. These students exhibited greater essential skills and it carried out learning effectively with greater improvement in their academic performance. In addition, Basri et al. on the other hand explored the relationship between ICT adoption and students' performance. They revealed a significant positive association and found that ICT adoption by students resulted in the improvement of students' performance. Mohafa et al. (2022) in their experimental study found significant results of ICT intervention on students' achievement as compared to conventional teaching. Moreover, Simoes et al. (2022) examined computer factors that influence students' performance. The study revealed that most important factors positively affect students' performance. The factorial analysis also revealed that there is no difference can be seen between the students who received pre-test and the students who did not receive the pre-test. The intervention lasted for 3-month duration, which may have produced such results.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

CONCLUSIONS AND THE WAY FORWARD

Students outperformed in post-test who received intervention as compared to the control group. Therefore, it was concluded that IWB and other computer assisted technology used for teaching physics has created interest among students for learning process. The teachers who implemented the strategy have reported that it build confidence among students and they reported better skills of demonstrating the procedures of different physical measurements or use of tool for conducting the physics experiments. In addition, the results revealed that students showed interest in using ICT tools for learning different complicated concepts. The study also reported that students have approached different websites for consulting about clarifying their concepts by different platforms. These activities in results showed better performance of students who received intervention.

i. It was recommended that teachers may use ICT tools for teaching physics.
ii. It was suggested that ICT facilities may be provided to each secondary school by the government. These facilities included computer labs and IWB, which may be utilized by science teachers for teaching physics.
iii. The 21st century skills are needed for new generation. These skills may be imparted to students by the use of ICT tools during teaching and learning process.
iv. The curriculum developers may design the syllabus according the need of 21st century skills, which may target ICT based teachings.
v. The secondary school teachers in general and science teachers in particular may be guided and trained by I.T educators to device ICT tools as a part of teaching and learning process.

References

1. Ali, G. Haolader, F. A., & Muhammad, K. (2013). The role of ICT to make teaching-learning effective in higher institutions of learning in Uganda. *International Journal of Innovative Research in Science, Engineering and Technology, 2*(8), 61-73
2. Basri, W. S., Alandejani, J. A., & Almadani, F. M. (2018). ICT adoption impact on students' academic performance: Evidence from Saudi universities. *Education Research International*, *2018*, 1-9.
3. Ben Youssef, A., Dahmani, M., & Ragni, L. (2022). ICT use, digital skills and students' academic performance: Exploring the digital divide. *Information*, *13*(3), 129.
4. Çelik, B., & Gündoğdu, K. (2016). The effect of using humor and concept cartoons in high school ICT lesson on students' achievement, retention, attitude and anxiety. *Computers & Education*, *103*(2), 144-157.
5. Cuban, L. (2001). *Oversold and underused: Computers in the classroom*. Harvard university press, Cambridge, MA.
6. Ingleby, E. (2014). Selected student and tutor perceptions of ICTs in further and higher education in England. *Journal of Further and Higher Education*, *38*(3), 287-304.
7. Ishaq, K., Azan, N., Zin, M., Rosdi, F., Abid, A., & Ijaz, M. (2020). The impact of ICT on students' academic performance in public private sector universities of Pakistan. *International Journal of Innovative Technology and Exploring Engineering*, *9*(3), 1117-1121.

Jilin Daxue Xuebao (Gongxueban)/Journal of Jilin University (Engineering and Technology Edition)
ISSN：1671-5497
E-Publication: Online Open Access
Vol: 42 Issue: 06-2023
DOI 10.17605/OSF.IO/B8R7P

8. Kolikant, Y. B. D. (2012). Using ICT for school purposes: Is there a student-school disconnect?. *Computers & Education*, *59*(3), 907-914.

9. Lindqvist, M. J. H. (2015). Gaining and sustaining TEL in a 1: 1 laptop initiative: Possibilities and challenges for teachers and students. *Computers in the Schools*, *32*(1), 35-62.

10. Livingstone, S., Mascheroni, G., Dreier, M., Chaudron, S. and Lagae, K. (2015) *How parents of young children manage digital devices at home: The role of income, education and parental style.* London: EU Kids Online, LSE.

11. Male, T., & Burden, K. (2014). Access denied? Twenty-first-century technology in schools. *Technology, Pedagogy and Education*, *23*(4), 423-437.

12. Mark, O. O. (2017). Utilization of information communication technology (ICT) in teaching and learning technical drawing and mechanical designs in Nigerian schools system. *Gombe Technical Education Journal*, *10*(1), 41-52.

13. Mohafa, L. G., Qhobela, M., & George, M. J. (2022). Evaluating the influence of interactive simulations on learners' academic performance in stoichiometry. *South African Journal of Chemistry*, *76*(1), 1-8.

14. OECD (2015). *Students, Computers and Learning: Making the Connection.* PISA Series, OECD Publishing, Paris.

15. Olofsson, A. D., Lindberg, J. O., Fransson, G., & Hauge, T. E. (2015). Uptake and use of digital technologies in primary and secondary schools–a thematic review of research. *Nordic Journal of Digital Literacy*, *10* (Jubileumsnummer), 103-121.