# Effect of ICT Integration on Secondary School Students' Physics Achievement and Reasoning Skills

**Hakim Ali**
*Associate Professor, Department of Education,*
*Government Wilayat Hussain Islamia Graduate College, Multan, Punjab, Pakistan*

**Mariam Rafique**
*M. Phil Scholar, Department of Education,*
*Institute of Southern Punjab, Multan, Punjab, Pakistan*

**Bashir Hussain**
*Associate Professor, Department of Education,*
*Bahauddin Zakariya University, Multan, Punjab, Pakistan*
*bashirhussain@bzu.edu.pk*

## Abstract

*This study analyzed the effect of ICT integration on secondary school students' physics achievement and reasoning skills and used quasi-experimental pre-test post-test non-equivalent control group design. The study population comprised all the secondary school science students enrolled in grade 10th in secondary schools of district Multan. Two pre-existing/intact sections of grade 10th in one of the secondary schools constituted the study sample. Experimental group, comprising 31 students, was taught through ICT integration, while control group, comprising 30 students, was taught through traditional method. Researchers collected pre-test and post-test data using Physics Achievement Test (PAT). To measure students' reasoning skills, a questionnaire comprising ten close-ended items designed on Likert 5-point scale, was administered to students after post-test. Both descriptive and inferential analyses were used to analyze the data. Data analysis indicated that the experimental group, who received instruction through ICT, performed significantly better than the control group. Furthermore, results showed that ICT integration enhanced students' reasoning skills. Overall, this study revealed that the use of ICT integration has a positive effect on students' physics achievement along with their reasoning skills. Finally, this study provides useful guidelines for teachers, administrators, and policymakers for improving school students' academic performance.*

**Keywords:** *Information and Communication Technology, Secondary School, Physics Achievement, Reasoning Skills*

## Introduction

Integration of ICT into education is a top priority in many developing countries around the world (Arinze et al., 2012). The use of ICT in educational settings can assist students prepare to face the problems of twenty-first century. Due to ICT efficiency, its use in educational development and management has rapidly augmented (Ali et al., 2021). These benefits ensure that all the students have equal access to high-quality educational information and promotion of professional development (Saleem & Zahra, 2017). ICT can, therefore, easily handle following three key difficulties in education i.e., accessibility, inclusiveness and standard. Through self-instructed and critical analysis of information gathered and evaluated by ICT increases the bar for education (Shivakumar & Selvakumar, 2019).

The secondary school level, being a decisive stage in Pakistani formal education system, serves as a transitional period between lower secondary and higher education. At this stage of schooling, children are introduced to traditional teaching methods that mostly prepare them for exams and enthrall students into rote memorization of the material. The Board of Intermediate and Secondary Education, which is authorized for certifying teachers, does not evaluate students' reasoning skills, conceptual comprehension and/or higher order thinking. Consequently, many students in Pakistani education system successfully complete the Secondary School Certificate (SSC) exam each year with excellent scores but many of them still struggle to do well on tests that are dependent on reasoning and application such as admission tests.

Previous literature confirms that Pakistani secondary school teachers still continue to place an emphasis on the conventional "chalk & talk" method of instruction instead of implementing the use of ICT in the classroom (Rana & Mahmood, 2010). This shows that students in Pakistan still are not being enabled to adapt the changing international realities. This suggests that the benefits of ICT in the classroom may not be realized and that teachers and students in Pakistan may be missed out in international competitive scenario. Keeping in view this contextual scenario and a substantial role of ICT integration in assuring and boosting students' physics scholastic achievement and improving teachers' teaching quality, this experimental study analyzed the effectiveness of ICT integration in improving secondary-level Physics students' academic performance and reasoning skills.

**Significance of the Study**:

The findings of this study may help secondary school students to figure out how to make the best use of technology to improve their academic performance and reasoning skills. This needs to be done in conjunction with the right teaching methods. Likewise, secondary school teachers would be able to learn more about technology, how to teach to help students develop aptitudes for higher-level thinking and how to get students more interested in schoolwork to do better in school. This study may provide a roadmap for monitoring and evaluating the instructions of physics teachers and for improving their students' academic performance and reasoning capabilities/skills. Furthermore, this study may be useful help for future researchers. Future researchers may be able to do similar studies by extending it to other school levels or with other teaching techniques and methods.

In this context, researchers conducted this study mainly to assess the effect of ICT integration on secondary school students' physics achievement as well as of their reasoning skills. For this purpose, researchers formulated following four sets of hypotheses in this experimental study.

1. Ho 1: Students in control group are significantly not different from students in the experimental group in terms of their achievement in physics in pre-test at secondary level.
2. Ho 2: Integration of ICT doesn’t significantly affect their achievement in Physics in terms of the experimental group at secondary level.
3. Ho 3: Students in control group are significantly not different from students in the experimental group in terms of their achievement in physics in post-test at secondary level.
4. Ho 4: Students’ level of reasoning skills in control group is not significantly different from students’ reasoning skills in experimental group at secondary level.

## Literature Review

It is generally agreed that ICTs assist students and instructors in the process of achieving improved academic performance (Lechhab et al., 2021). The findings of several recent studies (i.e., Efe, 2015; Sparapani & Calahan, 2015) have demonstrated that Asian nations commonly adopt technology, but less commonly for enlightening resolutions. In order to develop knowledge and successfully convey understanding, students must actively participate in inquiry processes and hands-on activities during modern science learning (Cakir, 2011). ICT integration must be included in educational settings due to rapid growth of technology and the significance that technological resources now play in society as well as in digital world (Bourne, 2017).

In contrast to the traditional learning environment, this sort of integration enables educators and students to continue their education outside of school hours (Ali et al., 2013). The necessity to address students' all-encompassing academic accomplishments and their cognitive growth is essential (Temsah & Moukarzel, 2018). Using computer-assisted instruction (CAI), students can complete the course at home or at school because it is time and place independent. Additionally, learners who get instruction using ICT remember information better (Cotton, 2001). Furthermore, use of technology improves students' critical thinking which is required for active learning (Kim et al., 2014).

Hockicko and Tarjanyiova (2018) proclaimed that their students' involvement in class is one of the elements influencing students' improved orientation to their studies as well as their physics knowledge. Likewise, scientific literacy or reasoning skill is crucial in laying the groundwork for a talented workforce in the 21st century. The ability to reason scientifically demonstrates that students have internalized what they have learned in science class (Legare, 2014). Physics should be taught in a setting that is well-equipped because the field has made significant advancements. In order to analyze the causes of students' weaknesses, this study addressed the aforementioned reasoning domain for secondary school physics students.

Shanta and Wells, (2022) defined scientific reasoning as the process of addressing a problem by applying critical thinking to content knowledge, cognitive status and procedure of execution. For successful experimentation, hypothesis testing, data analysis, conclusion drawing and scientific reasoning is crucial in the study of science. Similarly, criticizing one's own reasoning, hypothesis testing and decision-making were all part of Hughes' definition of critical thinking in his book. Increasingly, the internet has served as a cutting-edge medium for exchanging ideas and data as well as enhancing cognitive abilities such as data analysis and application (Johnson et al., 2010). Bloom's Taxonomy is the tool for learners to boost their critical thinking. The Figure 1 highlighted the different skills of critical thinking that is needed in dealing with scientific reasoning.

**Figure 1**

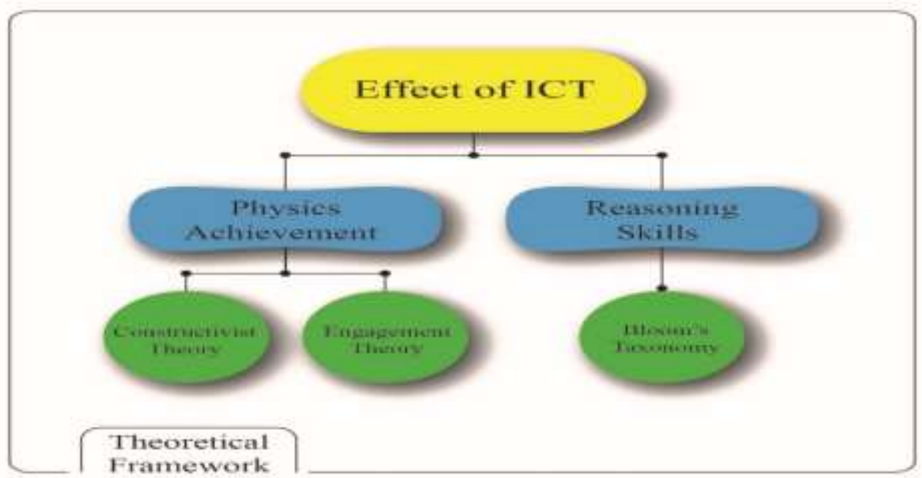
*Critical thinking skills*

Halpern (1986) defined that the term "reasoning" refers to the mental process of drawing conclusions, forecasting future events or developing explanations through analyzing and synthesizing information. The capacity for decision-making, aspect analysis and other mental abilities are all tested via reasoning. Collins (2020) stated that the "problem-solving" refers to the methodical approach to resolving any issue. The ability to make decisions it requires a complex set of mental operations, including perception, attention, and memory as described (Awidi & Paynter, 2019). The mental processes associated with complex cognition are not limited to the purely intellectual but also include the emotional and volitional (Chang & Kim, 2009).

The constructivist and engagement theory is the most extensively used theory in the field of ICT integration and students' achievement in literature (Bhagat & Chang, 2015; Kearsley & Shneiderman, 1999; Marshall, 2007). A clear shift from the traditional instruction or transmission's model of learning to the more recent constructivist or interactive-engagement approach is being followed in the field of physics education as shown in Figure 2.

**Figure 2**

*Theoretical framework for study*




Furthermore, when it comes to student-centered education, both theories have many similarities. Engagement theory serves as the theoretical foundation for this investigation. According to Engagement Theory (ET), students learn best when they are not passive observers but rather participate in class discussions and complete projects that have real-world applications (Kearsley & Shneiderman, 1999).

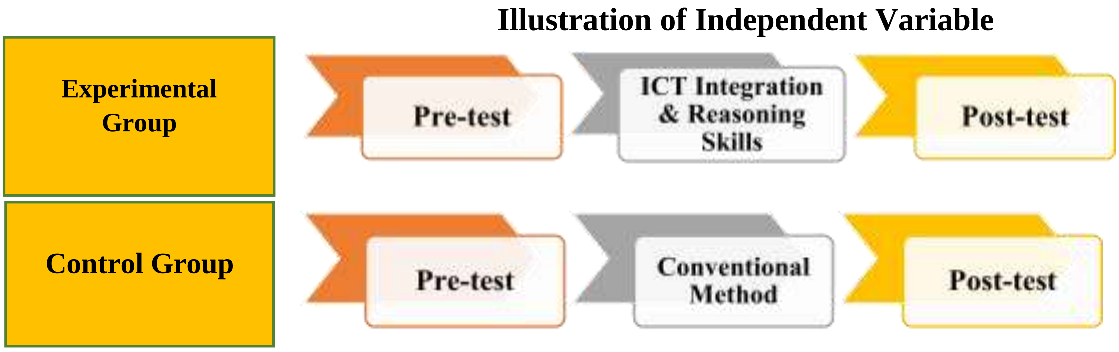
Teaching and learning in an ICT environment delivers relevant and authentic experiences for students (Kearsley & Shneiderman, 1999). ICT environments can encourage a kind of real-world situations that students will encounter outside the classroom. In the theory of engagement, there are three parts, teaching and learning activities in a group (collaborative work). Students are compelled to express their issues to find answers to this. Teamwork and open communication are emphasized. The second is Project-based learning activities. Students participate in the creation of their assessment problems and put their knowledge to use in a variety of settings. It places emphasis on originality and direction. Last, involving students in activities rooted in the real world.

## Research Methodology

This research used a quasi-experimental pre-test post-test non-equivalent control group design (Figure 3). The causal link between the independent and dependent variables is established by this design (Creswell, 2012). In this design, the researcher employs two non-randomly selected pre-existing groups that are otherwise complete. Control and experimental groups are selected non-randomly before treatment, with one group designated as the control and the other as the experimental (Creswell, 2012).

**Figure 3**

*Research design Quasi-experimental study*




All students of 10th class in all (537) public, private, and semi-government secondary schools (both for girls and boys) of district Multan, served as a population. The researcher conveniently selected one semi-government secondary school out of (537) schools because she was already working in this school as a physics teacher. The 10th class in this school comprised three sections, A, B, and C, with 91 students. The researcher selected two intact/pre-existing sections, section A with 31 students and section B with 30 students. Section A was entitled as experimental group and section B was considered control group. Consequently, 61 students were selected from class 10th for this study. Section 'A' experienced teaching through ICT integration, while the 'B' section experienced a traditional teaching approach.

The researcher developed two instruments, one is 10th grade Physics Achievement Test (PAT), and the second is a questionnaire for reasoning skills. The researcher constructed PAT based on the 10th-grade physics syllabus to assess students' physics skills. The test was developed according to the Board of Intermediate and Secondary Education, Multan (BISE) paper pattern. The test comprised 60 marks, which were categorized into three distinct sections. Specifically, 12 marks were allocated for multiple-choice questions, 30 for short questions, and 18 for detailed answer questions. Researcher employed equivalent pre-and post-tests to ensure test content, format, and cognitive level reliability. A group of six proficient subject matter specialists reviewed and verified the preliminary version of the PAT. In addition, 20 students in the 10th grade from a different school than the one chosen for the study's sample participated in a pilot test. The individuals who took part in the preliminary examination were instructed to furnish their evaluations concerning the pertinence and structure of the test items, the comprehensibility of the test, the duration of time needed to complete the test, and any additional apprehensions they may have had regarding the test. The PAT was ultimately established by the modifications proposed by the expert panel and the individuals who participated in the pilot testing. Furthermore, Researcher used 10 items of the questionnaire developed by Temsah and Moukarzel (2018), to measure students' perceptions about development of their reasoning skills.

This experimental study was carried out in Divisional Public School (DPS) Multan (sample school) after receiving necessary approvals from the school administration. Before the execution of intervention, students from both the groups (experimental and control) were pre-tested with PAT to determine their academic level. Independent Samples t-test revealed no significant difference in their academic achievement and both the groups were found to be almost similar before treatment.

Researcher designed forty lesson plans for the eight-week intervention, five for every week with 40 minutes per class. Before classroom instruction began, subject-matter experts reviewed and approved all the lesson plans. These same lesson plans were used to teach the students in both the groups. As the researcher was an ICT-trained physics teacher, she herself taught the lesson contents to the experimental group with the use of ICT integration while another Physics teacher taught the same contents to the control group in traditional way according to the school timetable.

After completion of eight-week instructional treatment, a post-test was administered to students of both groups to measure effects of ICT Integration on students' achievement in physics in secondary school. Finally, a self-developed questionnaire comprising two sections was also administered to the students to measure students' reasoning skills.

## Data Analysis and Results

Researchers performed two types of analyses. First, descriptive analysis was done to calculate frequencies and percentages of participants' demographic information as well as mean scores and SD of their Physics achievement test scores. Furthermore, Independent samples t-test and Paired samples t-test were used. T-tests were performed to compare mean scores of groups to ascertain if the homogeneousness and/or heterogeneousness exist or not. Both of the above-mentioned t. tests were performed with setting of Alpha level at 0.05. Table 1 to Table 4 below indicates the results with their interpretation.

**Table 1**

Sample students' demographic

| Grade | Gender | Age Group | Group | n | %age |
|---|---|---|---|---|---|
| $10^{th}$ | Female | 14-16 Years | Control | 30 | 49.10% |
| $10^{th}$ | Female | 14-16 Years | Experimental | 31 | 50.80% |
| $10^{th}$ | Female | 14-16 Years | Total | 61 | 100% |

Table 1 shows that 31 (50.8%) of the 61 students in the sample were in the experimental group, and 30 (49.1%) were in the control group. This sample group of 61 students had a mean age of 15 years. The students in both the groups were between 14 and 16 years old.

**Ho 1: Students in control group are significantly not different from students in the experimental group in terms of their achievement in physics in pre-test at secondary level.**

**Table 2**

Independent samples t-test for pre-test scores

| Category | Group | n | Mean | SD | df | t-value | Sig |
|---|---|---|---|---|---|---|---|
| Pre-test Results | Control Group | 30 | 32.80 | 8.16 | 59 | 1.088 | 0.281 |
| | Experimental | 31 | 30.25 | 9.96 | | | |

**Figure 4**

*Independent samples t-test for pre-test scores*

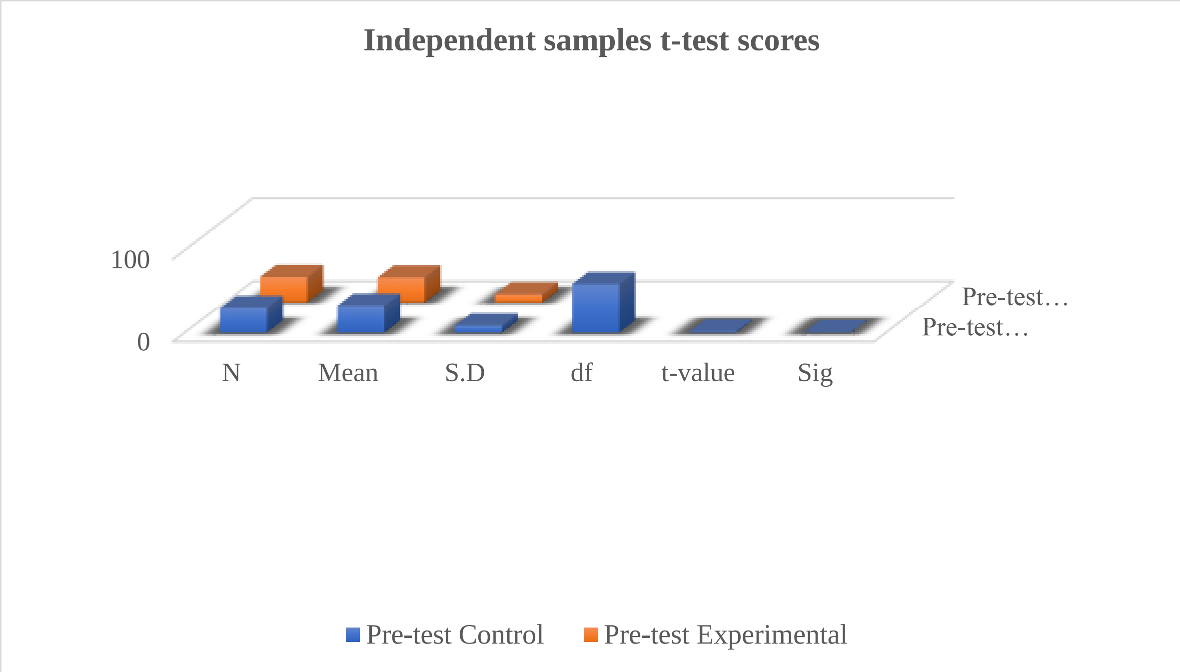



Table 2 and Figure 4 exhibit the scores of the control and experimental groups in pretest. The Table 4.2 further shows the statistics of control group (M=32.80, SD=8.16) and experimental group (M=30.25, SD=8.16). The signature value higher than 0.05 (p=0.281), supports the hypothesis. The performance of both groups was almost same in pretest. This demonstrates that the physics knowledge and academic ability of both groups before treatment was comparable and almost equal.

**Ho 2: Integration of ICT doesn't significantly affect their achievement in Physics in terms of the experimental group at secondary level.**

**Table 3**

Differences in post-test scores using independent samples t-test

| **Category** | **Group** | **n** | **Mean** | **SD** | **df** | **t-value** | **Sig** |
|---|---|---|---|---|---|---|---|
| Post-test | Control | 30 | 36.83 | 11.17 | 59 | 7.685 | 0.000 |
| | Experimental | 31 | 53.64 | 4.76 | | | |

**Figure 5**

*Independent samples t-test for post-test scores*

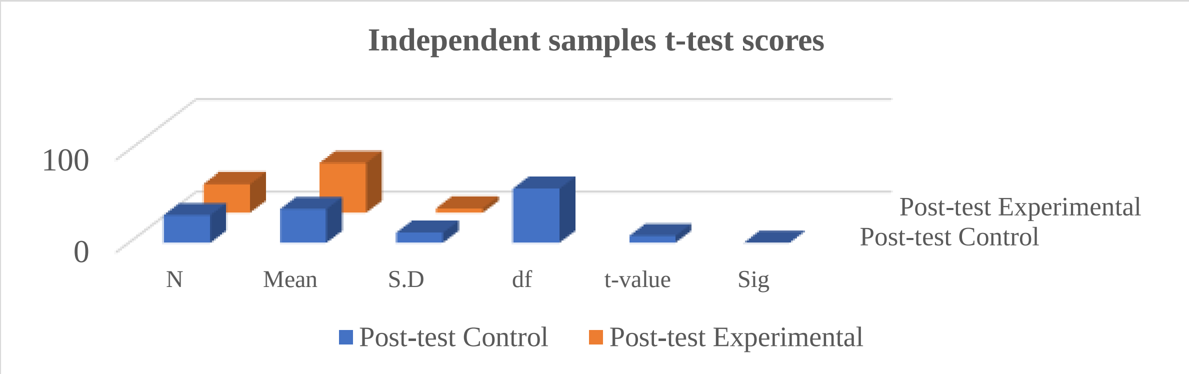



Table 3 and Figure 5 display the analysis of the control and experimental groups' mean physics post-test scores. Table 3 and Figure 5 also shows mean value and standard deviation for both the control group (M=36.81, SD=11.17) and the experimental group (M=53.64, SD=4.76). The signature value less than 0.05 (p=0.000) depicts that hypothesis is rejected.

**Ho 3: Students in control group are significantly not different from students in the experimental group in terms of their achievement in physics in post-test at secondary level.**

**Table 4**

Differences in pretest and post-test scores using paired samples t-test

| Group | Category | N | Mean | S.D | df | t-value | Sig |
|---|---|---|---|---|---|---|---|
| Experimental | Pre-test | 31 | 30.25 | 9.96 | 30 | 17.013 | 0.000 |
| | Post-test | 31 | 53.64 | 4.76 | | | |

**Figure 6**

*Paired samples t-test for pretest and post-test scores*

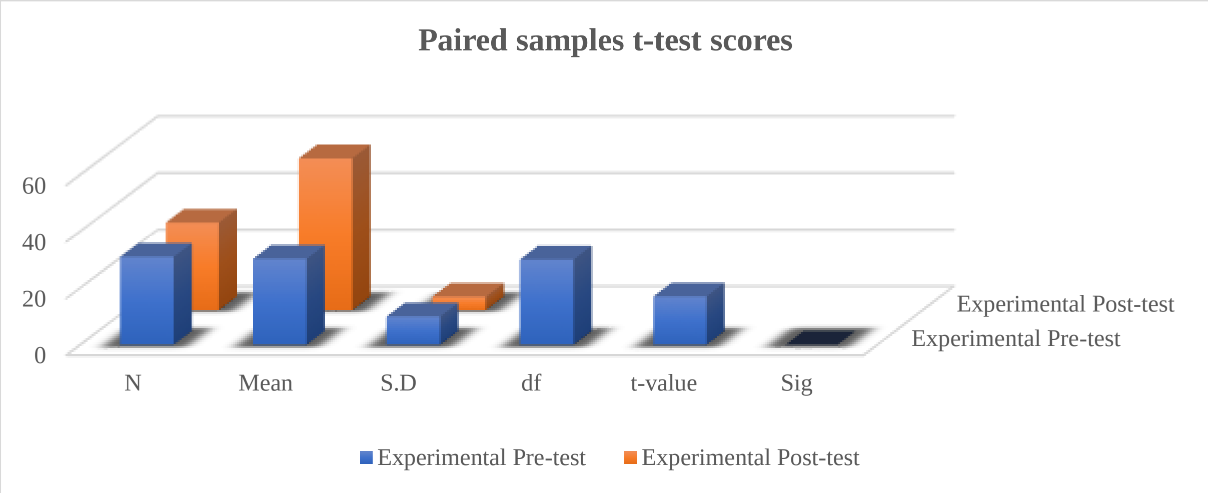



Table 4 and Figure 6 show the analysis of the mean physics achievement score of experimental group. The results reveal the experimental group's score of pretest (M=30.25, SD=9.96) and post-test score (M=53.64, SD=4.76). The null hypothesis is rejected since the p-value is 0.000 less than table value. This shows that experimental groups' mean physics scores before and after the test varied greatly and also suggests that ICT-based instruction improves secondary school students' performance.

**Ho 5: Students' level of reasoning skills in control group is not significantly different from students' reasoning skills in experimental group at secondary level.**

**Table 5**

Independent samples t-test for reasoning skills

| Group | N | Mean | S.D | df | t-value | Sig |
|---|---|---|---|---|---|---|
| Control | 30 | 3.25 | 8.60 | 59 | 1.06 | 0.000 |
| Experimental | 31 | 4.20 | 8.32 | | | |

**Figure 7**

*Students' reasoning skill response*

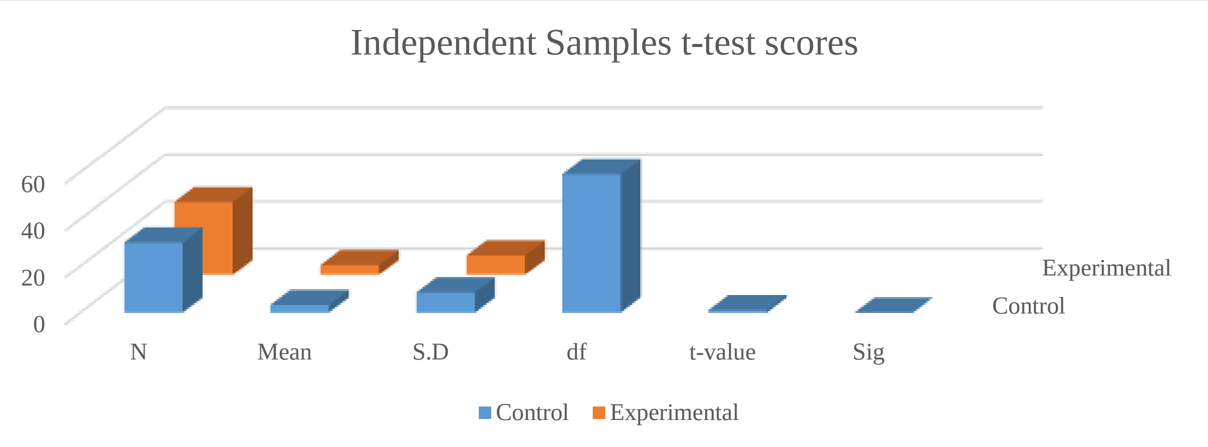



Table 5 and Figure 7 present the results of an Independent samples t-test used to compare perceived views of control group and experimental group with regard to improvement in their ability of reasoning skills. Table 5 and Figure 7 further demonstrate the mean values and SD for both the groups (M=3.25, SD=8.60) for control group and (M=4.20, SD=8.32) for experimental group and signature value ($p = 0.000$ less than 0.05). This evidence suggests that there is significant difference in students perceived reasoning skills' ability of both the groups and thus, null hypothesis is rejected.

## Discussion

Researchers conducted this study mainly to investigate the effect of ICT integration on students' physics achievement and reasoning skills at secondary level. This study found that both the groups performed identically before the treatment. In this study, ICT integration was found to be more effective in augmenting students' academic achievement in the subject of Physics than traditional teaching methods. These findings were found to be congruent with those of Agrahari and Singh (2013). They also concluded similarly and found that ICT has a beneficial effect for secondary school students' physics success achievement scores. Similarly, Ziden et al. (2011) found that the use of ICT in educational settings improved student achievement in science disciplines.

Likewise, a number of other previous scholars (Hull, 1995; Gayeski, 1993; Okoro & Ekpo, 2016; Safdar et al., 2011) found that ICT has a positive effect on students' achievement scores. Okoro and Ekpo (2016) concluded that students in experimental group, who were exposed to intervention, performed better than control group student taught using traditional method. Incorporating ICT into teaching motivates participants to improve their data processing, understanding, and recall (Hull, 1995; Gayeski, 1993). Avinash and Shailja (2013) revealed that students' physics test results improved significantly after adopting the ICT program compared to those students who used a more traditional teaching method. The findings of Cener et al. (2015), however, were contradictory to this study. They established that the use of ICT did not have an effect on students' accomplishment levels. Writing in same vein, Mbaeze et al. (2010) proclaimed that there was no substantial connection between information and communication technology and students' academic achievement. Moreover, in order to compare the significant differences between the experimental group and the control group's mean score in physics reasoning skills, the mean score of experimental group was significantly higher than the mean score of control group. These results are consistent with a previous study conducted by Azhary et al. (2020). In addition, studies of several other scholars (Ali et al., 2013; Kaleem et al., 2018; Temsah & Moukarzel, 2018) also have similar findings. They found that ICT integration had positive effect on students' learning (Ali et al., 2013); reasoning skills (Kaleem et al., 2018) and ICT integration improves secondary school students' reading comprehension (Temsah & Moukarzel, 2018).

## Conclusion and Recommendation

One of the key conclusion drawn from this study was that teaching through integration of ICT contributes significantly towards elevating secondary school students' academic performance and reasoning skills. This study found that ICT-integrated instruction improves secondary students' physics achievement and reasoning skills. Three important conclusions answered the research hypotheses. First, both groups had similar pre-test mean physics accomplishment scores. Before the treatment, students in both groups had equivalent academic levels. Second, this study found substantial differences in experimental groups' pre- and post-test mean physics accomplishment scores. This finding indicated that ICT integration has a major impact on secondary physics achievement. Third, post-test mean physics achievement scores differed significantly between groups. This showed that ICT integration boosts physics performance. Physics students also differed in reasoning skills. ICT integration improves pupils' reasoning ability. ICT improves productivity, information access, teamwork, and communication in education. Digital literacy, accessibility, and infrastructure must be addressed to ensure fair and inclusive access for all stakeholders. Furthermore, findings also indicated that ICT integration has a considerable and valuable positive effect on improving secondary school students' reasoning skills. This study recommends that school administration should make sufficient arrangements to ensure that instructors have the resources and training they need to fully incorporate ICT into physics lessons.

## References

Ali, H., Zulfqar, A., & Hussain, B. (2021). Perceived applicability of educational management information system (EMIS) in secondary schools using the TOE framework. Pakistan Social Sciences Review, 5(1), 581-596.

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.

Alwi, S. K. K., Rauf, M. B., & Soomro, S. (2016). Effects of cross and same age peer tutoring on reading attitudes of primary school students. *The Sindh University Journal of Education-SUJE, 45*(1)

Arinze, F. O., Okonkwo, E. N., & Iwunor, A. N. (2012). Information and communication technology (ICT) application in secondary schools and students' academic performance in social studies. African research review, 6(4), 266-278.

Agrahari, A., & Singh, S. (2013). The impact of information and communication technology (ICT) on achievement of students in chemistry at secondary level of CBSE and UP Board in India. International Journal of Science and Research, 2(8), 126-129.

Avinash, A., & Shailja, S. (2013). The impact of ICT on achievement of students in chemistry at secondary level of CBSE and up board in India. International Journal of Science and Research, 2(8), 126- 129.

Awidi, I. T., & Paynter, M. (2019). The impact of a flipped classroom approach onstudent learning experience. Computers and Education, 128, 269-283.

Azhary, S. A., Supahar, S., Kuswanto, K., Ikhlas, M., & Devi, I. P. (2020). Relationship between behavior of learning and student achievement in physics subject. Journal pendidikan Fisika Indonesia, 16(1), 1-8.

Bourne, D. T. (2017, July). An investigation of senior secondary school teachers' experiences of integrating information and communication technologies into teaching and learning in the era of Australia's digital education revolution.Retrieved from University of Wollongong Research Online: https://ro.uow.edu.au/theses1/76/

Bhagat, K. K., & Chang, C. Y. (2015). Incorporating GeoGebra into Geometry learning-A lesson from India. Eurasia Journal of Mathematics, Science and Technology Education, 11(1), 77-86.

Cakir, M. (2011). Enhancing mendelian genetics concepts using a guided computer mediated inquiry. Journal of Baltic Science Education. 10(3), 156-167.

Cener, E., Acun, I., & Demirhan, G. (2015). The impact of ICT on pupils' achievement and attitudes in social studies. Journal of Social Studies Education Research, 6(1),190-207.

Chang, M., & Kim, S. (2009). Computer access and computer: use for science performance of racial and linguistic minority students. Educational Computing Research, 40(4), 469- 501.

Creswell, J. W. (2012). Educational research: Planning, conducting, and evaluating quantitative and qualitative research (4th Ed.). Boston, MA: Pearson Education.

Collins, E. R. (2020). The problem of problem-solving courts. UC Davis L. Rev., 54, 1573.

Cotton, K. (2001). Computer assisted instruction. North-west regional educational laboratory. Retrieve from http://www.nwrel.org/scpd/sirs/5/cu10.html

Efe, H. A. (2015). The relation between science student teachers 'educational use of web 2.0 technologies and their computer self-efficacy. Journal of Baltic Science Education, 14(1), 142.

Gayeski, D. M. (1993). Multimedia for learning: Development, application, evaluation. Educational Technology.

Hull, D. (1995). Who are you calling stupid? The revolution that's changing education. Cord communications.

Hockicko, P., & Tarjanyiova, G. (2018). Interactive lectures from physics using program Tracker. In EDULEARN18 Proceedings (pp. 6069-6074). IATED.

Halpern, J. Y. (1986). Reasoning about knowledge: An overview. In theoretical aspects of reasoning about knowledge (pp. 1-17). Morgan Kaufmann.

Johnson, T. E., Archibald, T. N., & Tenenbaum, G. (2010). Individual and team annotation effects on students' reading comprehension, critical thinking, and meta-cognitive skills. Computers in Human Behavior, 26(6), 1496-1507.

Kaleem, D. S. M., Shaik, D. A., Shaik, D. N., & Bokhari, D. K. (2018). Stratagic assesment of use of "enjoy" audience response system (clicker) in graduate studies in King Khalid University College of Dentistry-abha-Kingdom of Saudi Arabia. Int J Dev Res, 8(02), 18852-18857.

Kim, K. H., VanTassel-Baska, J., Bracken, B. A., Feng, A., & Stambaugh, T. (2014). Assessing science reasoning and conceptual understanding in the primary grades using standardized and performance-based assessment. Journal of Advanced Academics, 25(1), 47-66.

Kearsley, G., & Shneiderman, B. (1998). Engagement theory: A framework for technology-based teaching and learning. Educational technology, 38(5), 20-23.

Khan, M. Y., & Alwi, S. K. K. (2018). EVALUATING TEACHERS'PERCEPTION ON INTEGRATING ICT IN TEACHING-LEARNING PROCESS. *Pakistan Journal of Educational Research*, *1*(1), 26-48

Lechhab, A., Hassouni, T., Benqassou, I., El-hars, F., & Hafid, M. M. (2021, June). The use of digital teaching resources in the physical sciences and their impact on the secondary school. In 2020 6th IEEE Congress on Information Science and Technology (CiSt) (pp. 215-218). IEEE.

Legare, C. H. (2014). The contributions of explanation and exploration to children's scientific reasoning. Child Development Perspectives, 8(2), 101-106.

Mbaeze, I. C., Ukwandu, E., & Anudu, C. (2010). The influence of information and communication technologies on students' academic performance. Journal of Information Technology Impact, 10(3), 129-136.

Marshall, S. (2007). Engagement Theory, WebCT, and academic writing in Australia. International journal of Education and Development using Information and Communication Technology, 3(2), 109 - 115.

Okoro, C. O., & Ekpo, E. E. (2016). Effects of information and communication technology (ICT) application on academic achievement of students in Christian religious studies in cross river state. International Journal of Interdisciplinary Research Method, 3(2), 14-24.

Rana, R. A., & Mahmood, N. (2010). The relationship between test anxiety and academic achievement. Bulletin of Education and Research, 32(2) 63-74.

Saleem, M., & Zahra, M. (2017). Effects of ICT on student's learning at secondary level in private schools of the Punjab. International Journal of Distance Education and E-Learning, 3(1), 69-89.

Safdar, A., Yousuf, M. I., Parveen, Q., & Behlol, M. G. (2011). Effectiveness of information and communication technology (ICT) in teaching mathematics at secondary level. International Journal of Academic Research, 3(5), 67-72.

Shivakumar, P., & Selvakumar, S. (2019). Blended learning package: It‘s effectiveness on students ‘performance and retention in higher secondary Physics Course. International journal of scientific & technology research, 8(10), 1316-1320.

Shanta, S., & Wells, J. G. (2022). T/E design based learning: assessing student critical thinking and problem solving abilities. International Journal of Technology and Design Education, 32(1), 267-285.

Sparapani, E. F., & Calahan, P. S. (2015). Technology in mathematics and science: An examination and comparison of instructional use in the United States and Taiwan. Education, 136(2), 242-252.

Temsah, L. O., & Moukarzel, D. M. (2018). Effect of technology on elementary students' reasoning & communication skills in science at Lebanese Private Schools: An exploratory study. European Scientific Journal, ESJ, 14(25), 107.

Ziden, A.A., Ismail, I. Spian, R., & Kumutha, K. (2011). The effects of ICT use in teaching and learning on students' achievement in science subject in a primary school in Malaysia. Malaysia Journal of Distance Education, 13(2), 19-32.