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Effect of Instructional Technology on Academic Achievement in General Science at Elementary Level: An Experimental Study

Nida Imdad[1], Dr. Fouzia Tabassum[2], Muhammad Ashraf Awan[3] & Dr. Muhammad Asghar Ali[4]

[1]*MPhil Scholar Department of Education, Women University of AJ&K Bagh, Email: nida.jaffri.52@gmail.com*
[2]*Principal FGPM School No 2 (II) Wah, Laiq Ali Chowk, Wah Cantt, Email: drfouziatabassum7@gmail.com*
[3]*Principal FG Public School No 3 Boys Wah Cantt, Email: ashrafawan110@gmail.com*
[4]*Professor (Adjunct), Department of Education, Muslim Youth University Islamabad, Email: aamasgharali@gmail.com*

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Corresponding Author:
Nida Imdad
Email:
nida.jaffri.52@gmail.com

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ABSTRACT

The purpose of this article is to find out the effect of instructional technology on academic achievement in general science 8th grade students in district Bagh Azad Kashmir. Instructional technology is very effective if used properly while teaching and learning process. The true experimental design was used by the researcher for this study to measure the effect of multimedia for the students of science. The achievement tests were used for students developed by the researchers. The instrument used in this study was vetted by the experts in the field of measurement and evaluation in the Faculty of Education to determine the face and content validity of the instrument. The multimedia was used as the instructional technology to motivate the students and accelerate the student's attention towards learning process. The findings show that instructional technologies (multimedia) have a significant effect on student's academic achievement. The performance of experimental group was better than the control group. Recommendations were made in-line with the findings, which include the science teachers should endeavor to use and try to improvise instructional technology for effective teaching of science.

Introduction

Before defining the instructional technology simply we define technology as the procedure by which man adapts environment to meet their requirements. Technology word is derived from the Greek word 'Technical' which means skill or ability and "logia" means study. Thus, technology means the study of a skill or ability. Educational technology is extensive and inclusive subject, and it is not possible to conquer it as a single subject. So it has been divided into four categories i.e.

instructional, teaching, behavioral, and instruction design or management (Sharma & Sharma, 2006). He further distinct educational technology as "field of study that permits man learning through systematic identity, association, growth and consumption of education assets and through the organization of procedures, but it also have the people who carry out these procedures. No reason can be explained by technological literacy, which includes three interdependent thinking and acting in science and research. In order to reach all students, teachers must adopt technology, becoming digital also to three settlers, who were not born, but in the digital world, but at some time later in our lives, and many have remained fascinated by usually making technology (Prensky, 2009). Educational technology is the branch of education that is related to the scientific study of academic and relevant development. The term "instructional technology" emerged in the late 1960s and the term was used during those years in audiovisual media, which included radio and television films. But during the period, new technologies arrived at their education and obtained their place and this trend continues.

Instructional technology is a systematic way of designing, carrying and using the human procedure in accordance with specific objectives based on research into human objectives and communication, in accordance with the specific objectives of learning and teaching. There are many types, which include instruction boards, online journals, websites and blogs, computers, digital microphones, mobile devices, online study tools, but researchers as multimedia technology for teaching science in general. Schnotz and Lowe (2003) described the term multimedia as a combination of multiple technological resources to present information represented in multiple shapes through sensory modes. Vaughan (2008) Computer-controlled Multimedia Interactive Communication System described the store, textual and symmetrical information delivery and receipt as a type of networks. All elements of technology, multimedia representing simultaneously besides sound, image, video, graphic and text interactive environments (Fouda 2013) combined with high quality. For some districts, the days of overhead projectors are long gone. Many districts now turn to document projectors, such as the Elmo. These projectors are connected to multimedia projectors and can display any document, not just those that have been copied onto an overhead transparency. Teachers can use projectors such as the Elmo to share text and lesson examples. Math teachers, for instance, can use a regular calculator on an Elmo. Students can also easily show other students their work with these projectors. No special copying is needed. Many Elmo models also offer a digital document camera. The projector can take a picture of a particular document and store it on a memory card for later use.

Multimedia systems focus on creating an environment of complete and efficient learning (Cerghit 2008). The self-learning strategy has computer and multimedia technology educational effects which, but using their integration and not thought well-trained." The same author recently said that "audiovisual message from the need of effective effects that, but the presence of the teacher, through the strategy of learning and self-learning, requires their effective integration. It is not a simple technical composition It is not said education, but on the guarantee of unity of the technical and appeals aspects - informative about educational work (Ionescu 2009). It is an interactive and nearly autonomous access to knowledge, which is not needed for the information based on observation, experiences, discovery of the teacher, which is the knowledge-based approach of information and soon, use multimedia (Ionescu 2009). Due to the rapid integration of this technology in the field of education, academic literature is a new concept of learning a variety of innovative approaches as a new concept, "As a new concept, but the need to take the school's new take on responsibility what is a form of learning is not just based on a self-discovery of new knowledge, but through interactive approaches, solving problems (Albulescu, 2013). Multimedia programs provide different stimuli in their presentations which include a number of elements some

of which are Aloraini, (2005): Texts, spoken words, sound & music, graphics, animations and still pictures.

Mayer (2001) "A multimedia message instruction is a presentation containing pictures that are designed to promote words and meaningful learning. Reddi and Mishra (2003), "integration of more media of a synergetic and symbiotic whole (audio, video, graphics, text, sound, etc.) that provides the maximum benefit to the end user in any comparison of the media. Multimedia has succeeded in psychomotor development and strengthening of visual processing of the intended users in multi-disciplinary multimedia educational programs where DVDs were also used as multimedia technology (Malik & Agarwal 2012). Students will be successful in their learning task if they interact meaningfully with their academic material, select relevant verbal and non-verbal information, organize information into corresponding mental models, and integrate new representations with existing knowledge when learning with multimedia (Mayer 2002). Gilakjani (2012) mentioned three reasons and the rationale for the use of multimedia in the classroom. According to him, its use increases students' interest level, enhances their understanding, and increases their memorizing ability.

Statement of Problem

According to Sassoon (2007) a problem is an existing negative state of events that avoid in attaining the set goals, in this study the existing problem is lack of effective use of instructional technology in science lesson at elementary level. IT plays a vital role of in the implementation of science lesson. They form focal point and attract attention, arouse interest and promote a desire to learn, supplement description and help to explain words and processes give an accurate impression of the concepts, illustrate relationships, and promote retention and memory and much more. The issue of concern in this study is to identify the scarce availability and less use of IT in the teaching of science and how it affects students in their learning. The reason to choose elementary level was based on the thought that this is very sensitive and crucial stage for the students because they have to decide about their carrier right now. If their concepts will be clear then they will feel no problem to choose about their field and multimedia is an aid which helps to brought clear concepts to the students which they really need at this level and they need motivation which multimedia enables.

Objectives of the study

The objectives of the study are as following:

1. To find out the effects of multimedia on academic achievement of experimental group in the teaching of science at elementary level.
2. To find out the effects of multimedia on academic achievement of control group in the teaching of science at elementary level.
3. To compare the academic achievement of experimental and control groups.

***H_0*:** No significant difference was found between achievement of experimental group and control group of students

Literature Review

The word multimedia emerged in the 1990s and was distinct by Reddi and Mishra (2003) as: "A compatible and symbiotic set is integrated into multiple multimedia elements (audio, video, graphics, text, animation, etc.) that provide more benefits to the end user compared to the elements of the individual at elementary level of their school." Mayer (2005) comprehensive the definition: "The message of a multimedia instruction is a presentation that includes words and images that are

ready to promote reasonable education". According to Jonassen (2000) these definitions are combined with "integration of more than one medium in some form of communication" and "a system integrates media such as text, sound, graphics, animation, video, photos, and local modeling. Interactive multimedia content that can be created to students can be delivered in different ways. Some of these methods focus mostly on demonstrators and presentations, simulations and practices, and lessons, learning about teachers and collaboration, solving issues and web-based learning, teaching and learning teachers at elementary level. There are ways in student teaching and learning methods. (Newby 2001). Multimedia is typified by the text presence, images, sound, animation and video; some or all of which are prearranged into some logical program (Mishra, Sharma & Ramesh 2004). Harnet (2001) shared that perspective by saying that at elementary level media tools appeal to the students' senses and help them process information, thus empowering their understanding of target culture and increasing their motivation toward language learning, reinforcing the teaching points, and saving the teacher unnecessary explanation. Ivers and Baron (2010) stated that multimedia allows to convey the understanding of a topic in a variety of ways, provides the students with opportunity to explain their ideas to others. It also provides the students with a communication and offers them new insight into organizing, and evaluating information.

Multimedia learning materials are the use of computer to present and combine text, graphic, audio, video, and animation with links and tools that let the users interacts, create, and communicate. Neo (2010) has begun research on multimedia learning and study results that by establishing an authentic work, through multimedia project, in the environment of building education, students encouraged students in highly motivated and active went. Strengthening and encouraging teachers and teaching teachers to include multimedia technology and to incorporate construction education in their classrooms. Columbia Encyclopedia has introduced Multimedia into "Personal Computing, Software and Applications, which includes text, high-quality sounds, graphics two and three dimensions, animations, pictures, and full motion video (Lagasse 2000). Altherr, Wagner, Ecker & Jold (2004) declared that multimedia fundamentals have supreme importance in science subject teaching at the level of elementary since it assists to present various facts and procedures brightly, replicate multifaceted stuffing and present various levels of concepts.

Ogunbote and Adesoye (2006) said that multimedia technology adds a new dimension to learning experiences because it was easy to present and understand words when imagery photos and animations were completed. Furthermore, it is certain that it has been established that the teachers remain more and more when different types of vocabulary are involved in the knowledge of the knowledge; and the intensity of experience maintains and maintains the participation of social, emotional and intellectual emotions. Text and computer generated graphics are stored on the same screen, especially if the graphics move or sound is available. Ideally, the multimedia system provides all the necessary hardware and software in the same box to combine fixed and animation images, including video, sound, text, and computer generated data and programs. A multimedia program can be recorded in the same optical fiber of sound, pictures, text and data. A useful starting point is to go back to the 1970s to a time when computers were still huge unfriendly devices demanding air-conditional environments and costing mullions. Even if desktop computing had not yet been invented, the term 'multimedia' was already in use. In the world of educational publishing in particular, multimedia meant kits, typically a combination of pupils' booklets, teacher's guides, film strips, audio tapes, and photographic slides. Such products, attractively boxed and delivered to the classrooms of the early 1970s, certainly offered multiple media text, images and sound but each was delivered as an independent element in the package.

After mentioning the previous methods in a developed country, Fieldman mentioned the applications and failures of various media in the past. We have to consider this important aspect. He wrote: "We can analyze the potential causes of multimedia failure in the classroom in the 1970s. One obvious reason is directly related to our search for any identification of multimedia, as it refers to. In the mid-1990s, the multimedia environment is dramatically different: electronic technology is the first step in various multimedia identities. Provide a unique source of information to diversify different types of communication. Focus on your strength to collect categories, detect them in a digital environment and stored by computer system to provide access to Services, which is fast, friendly and above all, interactive. Now, we have an identity for multimedia, a definition of work that we can measure and develop potential effects. We can describe Multimedia in the following ways: "Multimedia is the best integration of data, text, sound and all types of images in the same digital information environment." Omagbemi (2004) said that changes in access to multimedia information can be encouraged and can create an environmentally friendly environment to the students of elementary level and helps students learn more specific and local needs more affordable and responsibly. .

Anboucarassy (2010) conducted a study to find out the effectiveness of multimedia approach over the conventional method in teaching science among 8th standard students. The study revealed that there was a significance difference in the achievement of the experimental group over the control group. It was also found that multimedia helped the students in the experimental group to sustain their interest and also their retention power as compared to the traditional method of teaching. The investigator concluded that the multimedia approach is considered to be one of the best techniques for teaching science at 8th standard level. A study entitled “Learning with Multimedia: A constructive cooperative approach in education” and concluded that most of the multimedia programs for educational purpose create situations that enable students to interpret information for their own understanding. Reddy, Ramar, and Ponnambalam (2009) tested the effectiveness of multimedia based modular instruction on the achievement in Science of problem students. Two matched groups of problem students were constituted for the experiment. The problem students in the Control Group were given routine treatment during the school hours. The problem students in the experimental group were subjected to multimedia based modular instructional strategy for a period of three months. The obtained results established the effectiveness of multimedia based modular instruction on the achievement in Science of the problem students. Multimedia approach to teaching‟, stated that a variety of resources, starting from the traditional media to the internet, are now accessible and if multimedia is to be taken advantage of in the teaching-learning process, teachers have to use their imagination, ingenuity and initiative. Nimavathi and Gnanadevan (2008) developed a multimedia program for the teaching of Science in standard 8th. They studied its effectiveness over the conventional method of teaching. The study revealed that the multimedia programmer prepared by the researchers has an impact on learning of standard 8th students and also in their attitude towards use of computers. Susan (2008) in her paper “Multimedia packages: Relevance for effective evaluation”, explains the importance of multimedia packages in the present scenario, role of teachers in multimedia approach and evaluation of a Multimedia package. A structure of a multimedia evaluation preformat was also presented in this paper. She is of the view that the multimedia package should be evaluated in terms of the presentation of the content, teaching experiences given, language used, computer potentialities, etc.

Multimedia enhances effective self-learning”, emphasized the need and importance of learning by using self-learning multimedia CDs, and dwells on the quality as well as quantity of teaching and learning, bringing forth the need and significance of learning Science through self-learning with the help of CD-based Courseware. Anshu (2006) made a comparative study of the effectiveness of

single medium and multimedia on learning gains of 8th graders in science at different levels of academic achievements and intelligence. The study revealed that multimedia is as effective as the traditional method for the teaching of science to develop the "knowledge" and "understanding" domains of students having different and varied abilities. Blijleven (2005) carried out a study entitled "Multimedia cases: towards a bridge between theory and practice". The study was conducted within the context of the Multimedia in Science and Technology Project. The project developed and investigated multimedia cases for the professional development of prospective teachers in elementary science education. They found that a multimedia case via guiding task contributes to a meaningful interaction between theory and practice.

A multivariate analysis of students‟ perceptions regarding web-based multimedia materials as learning tools for human anatomy. The study was conducted to investigate the relationship between three educational factors and to determine which sub categories among the educational factors significantly affect the learner's perception. He concluded that the web-based multi-media materials were useful for both anatomical lab activities and knowledge construction.

Research Methodology

This study is experimental in nature and true experimental research was carried out. The researcher used equivalent group design post-test only for this study which involved two groups; Experimental and Control. All the 8th grade students in district Bagh were the population of the study. Kashmir Model School and College was selected for further research. All 20 students studying in class 8th in Kashmir Model School and College Bagh Azad Kashmir were selected as sample. Two groups were formed on the basis of marks in the achievement test taken before the conduct of experiment. The marks were arranged in ascending order with serial numbers, and, then divided into two equivalent groups on the even/odd basis odd numbers were in control group, and even in experimental. Achievement tests were made according to the bloom's taxonomy and first three levels (Knowledge Level questions, Comprehension level Questions and application level questions) were constructed. There were 10 MCQ's and 5 short questions in each test. Lessons plans were made which was to be delivered to the experimental and control group. Multimedia presentations were delivered to experimental group only and traditional method was used for control group. The test reliability was found out by running reliability test in SPSS. The value of Cronbach alpha was found .870. For validity achievement test were sent to experts and the suggestions given by expert were incorporated in the tests. In the sampled school experiment was taken among the students. Researchers faces many difficulties because multimedia was not available in the school so, firstly the researcher arranged the multimedia and then they implement it. But the researcher was successful in the conducting tests and collecting data from experimental and control group. Lessons were delivered with the help of multimedia to experimental group and control group was taught using traditional method of teaching science, and the post test was given from the sampled students and the results of experimental group were compared with the results of control group.

Data Analysis

Data analysis is obviously the most important stage in research. It is through this the researcher finds out truth and mentions facts about the phenomenon under consideration. Present study is experimental in nature and the data has been analyzed using tables showing the average scores, and by applying independent sample t-tests.

Table 1. Result of t-test Overall Achievement Score

Level	Groups	N	Mean	Std. Deviation	t-value	df	Sig	Cohen's d value
Overall score	Experimental	10	53.50	2.46	7.771	18	.000	3.48
	Control	10	43.20	3.39				

The independent samples *t*-test results in table 1 indicate a statistically significant difference in overall achievement scores between the experimental group (M = 53.50, SD = 2.46) and the control group (M = 43.20, SD = 3.39), t (18) = 7.771, $p < .001$. The effect size, Cohen's $d = 3.48$, suggests an extremely large practical significance, indicating that the experimental group substantially outperformed the control group in overall achievement. This implies that the intervention applied to the experimental group had a strong positive impact on performance.

Table 2. Result of t-test Achievement Score of Knowledge Level Questions

Level	Groups	N	Mean	Std. Deviation	t-value	df	Sig	Cohen's d value
Knowledge Level Questions	Experimental	10	18.80	.789	4.756	18	.000	2.13
	Control	10	15.40	2.119				

The independent samples *t*-test shows a statistically significant difference in knowledge-level question scores between the experimental group (M = 18.80, SD = 0.789) and the control group (M = 15.40, SD = 2.119), $t(18) = 4.756$, $p < .001$. The effect size, Cohen's $d = 2.13$, indicates a very large practical effect, demonstrating that the experimental group performed substantially better than the control group on knowledge-level questions. This suggests that the intervention had a strong positive influence on students' knowledge acquisition.

Table 3. Result of t-test Achievement Score of Comprehension Level Questions

Level	Groups	N	Mean	Std. Deviation	t-value	df	Sig	Cohen's d value
Comprehension Level Questions	Experimental	10	18.40	1.265	6.866	18	.000	3.07
	Control	10	14.10	1.524				

The independent samples *t*-test reveals a statistically significant difference in comprehension-level question scores between the experimental group (M = 18.40, SD = 1.265) and the control group (M = 14.10, SD = 1.524), $t(18) = 6.866$, $p < .001$. The effect size, Cohen's $d = 3.07$, indicates an extremely large practical effect, showing that the experimental group outperformed the control group by a substantial margin. This suggests that the intervention was highly effective in enhancing students' comprehension abilities.

Table 4. Result of t-test Achievement Score of Application Level Questions

Level	Groups	N	Mean	Std. Deviation	t-value	df	Sig	Cohen d value
Application Level Questions	Experimental	10	16.30	.823	5.488	18	.000	2.45
	Control	10	13.70	1.252				

The independent samples *t*-test indicates a statistically significant difference in application-level question scores between the experimental group (M = 16.30, SD = 0.823) and the control group (M = 13.70, SD = 1.252), $t(18) = 5.488$, $p < .001$. The effect size, Cohen's $d = 2.45$, reflects a very large practical effect, demonstrating that the experimental group achieved notably higher application-level scores than the control group. This suggests that the intervention had a strong positive impact on students' ability to apply knowledge.

Table 5. Summary of effect size

Table	Description	Cohen's d	Effect Size
1	Overall Achievement Score	**3.48**	Very large size
2	Knowledge Level Questions	**2.13**	Very large size
3	Comprehension Level Questions	**3.07**	Very large size
4	Application Level Questions	**2.45**	Very large size

Conclusion

The intervention significantly improved students' performance at the knowledge, comprehension, and application levels, leading to a substantial increase in their overall achievement scores. The extremely large effect sizes across all domains confirm that the difference between the experimental and control groups was both educationally and practically meaningful. These results provide strong evidence that the instructional strategy implemented is highly effective in enhancing student learning outcomes across different cognitive skill levels. Collectively, these findings indicate that the intervention was not only statistically significant across all cognitive levels but also produced very large and practically meaningful improvements. The consistent pattern of results suggests that the teaching approach used in the experimental group is robust and effective for enhancing multiple dimensions of learning.

Recommendations

1. Integration of Intervention into Teaching Practices – Schools and educators should adopt the intervention as part of regular classroom instruction to boost performance at all cognitive levels.
2. Teacher Training Programs – Provide professional development workshops to train teachers in implementing the instructional approach effectively.
3. Curriculum Enhancement – Incorporate the intervention's strategies into the curriculum design to ensure alignment with learning objectives at knowledge, comprehension, and application levels.
4. Scaling Up the Study – Conduct similar research with larger, more diverse student populations to verify the generalizability of these findings.
5. Longitudinal Studies – Assess the long-term impact of the intervention on student performance to determine whether the gains are sustainable over time.
6. Technology Integration – If applicable, explore incorporating digital tools or resources to further enhance the effectiveness of the intervention.

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