Effectiveness of Multimedia Package on Student-teachers' Achievement in Information and Communication Technology (ICT) in Education Course

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In the present context of artificial intelligence, student-teachers need to understand technological applications in education and incorporate them into their classroom instruction. Technological applications help in connecting and collaborating beyond geographical boundaries. The student-teachers should be equipped with the knowledge and understanding of the benefits of incorporating technology into their teaching practices and it should be the focus of teacher-training to equip them with the necessary skills to utilize these applications in their practice. The ICT in Education course was introduced in one of the University's pre-service teacher education programs in India to facilitate student-teachers to gain the ICT skills needed to integrate it into teaching. This study demonstrates the effectiveness of the multimedia package on student-teachers at the pre-service level based on empirical evidence. Some of the findings suggest that the use of the multimedia package not only helps student-teachers identify and use resources effectively but also delivers the content meaningfully. The Multimedia packages could serve as a tool for educators to deliver subject content efficiently.

Keywords: multimedia package, student-teachers, information, communication technology, classroom instructions

INTRODUCTION

In a knowledge-based society, Information and Communication Technology facilitates knowledge access. As technology has engendered alterations in all facets of society, expectations from education are evolving in terms of students' capacity to function effectively. Today's students do not rely solely on books and classroom lectures. They augment their classroom experience with the help of the Internet and its applications. In the technological world, it is necessary for students to have experiences to collaborate and communicate with each other to accomplish tasks and generate knowledge. In lieu of this in all the education sectors, teachers' roles have transformed from being knowledge transmitters to facilitators. Teachers are expected to assist their students in

constructing knowledge and developing their learning abilities with the help of ICT. The integration of ICT in classrooms has been recommended by various policies at the national level beginning with the National Policy on Education 1986 (MHRD, 1986) to the latest National Education Policy 2020 (MHRD, 2020). There were initiatives at the international level recommending ICT in the education sector such as UNESCO (2002, 2009) and UNESCO ICT-CFT (UNESCO, 2011).

As we know multimedia technology is among the most significant innovations in the information age, as it transforms the methods of delivering instruction. Multimedia is highly beneficial in research, teaching, and learning in various forms, such as interactive multimedia, multimedia presentations, and hypermedia. Multimedia technology involves judicious mixing of different media, including audio, video, text, graphics, and animation, on a specific platform. It is a set of information technologies that satisfies the growing demand of end-users for richer interactive experiences (Hong et al., 2003). Multimedia has a significant impact on the human mind in the form of movies, videos, games, software, or the Internet. Multimedia has evolved through technology, learners, and understanding of the teaching-learning process (Dobbs, 2003). Stemler (1997) posits that multimedia learning is a process rather than a technology that places new learning potential in users' hands. This indicates that multimedia-based instructions provide an effective way of instruction to sustain students' interest in learning.

Review of Related Literature

Studies conducted on the well-designed multimedia strategy have indicated that it can help offset the impact of intelligence on academic performance and lower the cost of instruction and increase its efficacy when combined with pedagogy (Menon, 1984). Colon et al., 2000, found the effectiveness of the multimedia packages using the constructivist instructional design model, R2D2, for teaching critical quality research. Neo and Neo (2001) argued that multimedia-oriented projects, similar to other problem-based learning solutions, could serve as innovative and effective tools in a problem-based learning environment to acquire problem-solving skills.

In line with these findings, multimedia in Technology Education was found effective in improving college students' comprehension, problem-solving skills, and positive attitudes toward instructional effectiveness (Sanders, 2002). Moreover, it was found effective at school level (Tupe, 2015; Komalasari & Rahmat, 2019; Nakpong & Chanchalor, 2019; Lauc et al., 2020; Yasin et al.,2021, Hasanah et al., 2023; Dong et al., 2024). The use of multimedia-based animated demonstrations is a valuable instructional strategy for teaching computer software procedures (Vadivel et al., 2019, Terentyeva et al., 2019; Vicneas et al, 2020; Yang, 2023). Research has shown that multimedia-based learning is effective in Indian classrooms in improving achievement (Irudayam, 2015; Shukla, 2017; Indira, 2020; Kumar, 2021; Nachimuthu & Sasi, 2021; Kaur et al., 2022; Dhivya et al., 2023).

Further, the studies were conducted at the tertiary and teacher education level indicating the effectiveness of multimedia for teaching computer education, instructional

technology and other courses (Kavita, 2018; Tiwari, 2021; Kumar, & Ramani, 2022; Jeya & Saravanakumar, 2022).

It can be said empirically that integrating multimedia in teaching and learning enhances student interest, achievement, and motivation. Over and above this, past research on incorporating technology into education has reiterated the significance of using technology to meet students' needs and expectations (Takwal, 2003; Rani & Shukla, 2014). Research studies conducted in the past have revealed the importance of technology and recommended integrating technology at the pre-service level. However, very little is known about using multimedia packages to support pre-service teachers in acquiring the course objectives of ICT in education. Also, there is very little evidence of multimedia approaches that would support pre-service teachers in planning their teaching practice. Considering this research gap, the authors of this paper thought about exploring the effectiveness of the multimedia package on student-teachers' achievement in ICT in education course at the pre-service level.

 The following were the research objectives for the study.

1. To study the effectiveness of the developed multimedia package with respect to academic achievement in the pre-test and post-test of student-teachers in the experimental and control groups.

2.. To study the reaction of the student teachers of the experimental group to the developed multimedia package.

Hypothesis of the study

There will be no significant difference in the mean achievement scores of student-teachers between the experimental and control groups in the pre-test and post-test.

METHOD

This study utilized an experimental design, specifically a quasi-experimental pre-test post-test non-equivalent group design. The researchers selected the samples purposively and conducted a real-time experiment. The study comprised of two variables: academic achievement (dependent variable) and use of multimedia package in instruction (independent variable). The sample for the study, tools and techniques used for data collection and data analysis are described below.

Population and Sample

The study population consisted of all B. Ed. student-teachers studying in English-medium B.Ed. institutions of Gujarat, India. The student-teachers from one of the institutions were assigned to the experimental group, while the student-teachers from the other institution were designated as the control group. Student teachers opting for Science/Chemistry/Physics/Biology methods courses were considered as a sample for the study. There were 32 student-teachers with Science/Chemistry/Physics/Biology pedagogy in both the experimental and control groups.

Tools and Techniques for Data Collection

An achievement test was developed and used to assess student teachers' performance before and after the experiment in the ICT in Education course. To determine the reaction of student teachers of the experimental group to the multimedia package, a reaction scale based on Likert's five-point scale was used. The reaction scale was comprised of 25 statements, considering aspects such as the clarity and comprehensiveness of the concepts presented, the usability of the multimedia package, and its overall utility.

Data Analysis

The data from the pre-test and post-test were analyzed using quantitative data analysis techniques. Specifically, non-parametric techniques were utilized, as the samples were selected purposively. To analyze the post-test data, the researchers employed the Mann-Whitney U-test, which is considered the most potent non-parametric equivalent of the t-test from the parametric family. The researchers calculated the mean, standard deviation, standard error of the mean, and Mann-Whitney U-test. The data obtained from the reaction scale was analyzed using percentages, frequency, and intensity index.

FINDINGS

The data thus collected using the achievement test and the reaction scale was analyzed using the statistical technique described in the methods section. The analyzed data are presented objective-wise below.

For the first objective, the data collected from the achievement test were analyzed, and the results are presented below in Tables 1 and 2.

Table 1
Mean, standard deviation and standard error of mean wise distribution of academic achievement of student-teachers of experimental and control group

	N	Mean	Std. Deviation	Std. Error of Mean
Control Group	32	22.63	5.2	0.92
Experimental	32	28.72	4.91	0.86

According to Table 1, the average academic performance of the control and experimental group student-teachers was 22.63 and 28.20 out of 50 marks, respectively. The standard deviation of the achievement test was 5.2 and 4.91, respectively, for the control and experimental groups, with the standard error of the mean of 0.92 and 0.89, respectively. It can be observed that both groups exhibited comparable academic performance in ICT in Education, with a similar standard deviation and low standard error of the mean. Additionally, it can be inferred that the academic performance of the experimental student-teachers was superior to that of the control group. Therefore, it can be stated that both groups had comparable levels of achievement at the outset of the experiment.

Table 2
Summary of Mann-Whitney U-test, Sum of Ranks, U-value, z-value and probability

Type of Group	N	Sum of Ranks	U-value	Z-value	Probability (P)
Control	32	667	823	4.185	0.00003
Experimental	32	823			

Table 2 clearly indicates that the sum of ranks for the control group was 667, while the sum of ranks for the experimental group was 823. The U-value and Z-value were determined to be 823 and 4.185, respectively. These values were used to reference the null hypothesis (Ho) of z, which stated that if $z \leq 4.185$, then it referred to the table for normal probability. The two-tailed probability was determined to be 0.00003, which is less than the predetermined significant level (α) of 0.05. Therefore, the null hypothesis was rejected, and it was concluded that there was a significant difference in the academic achievement of the control and experimental groups of student-teachers.

Table 1 demonstrates that the mean academic achievement of the experimental group of student teachers, as calculated from the post-test, was greater than that of the control group. This difference could be attributed to the academic achievement in ICT and ICT skills, which were enhanced by the use of the multimedia package. This indicates that the developed multimedia package was more effective than the traditional approach in improving academic achievement in ICT. Therefore, it can be concluded that the multimedia package was significantly more effective in improving academic achievement in ICT than the traditional approach.

For the second objective, the data collected from the reaction scale was analyzed, and the results are presented below in Tables 3 to 7.

Table 3
Reaction of student-teachers on clarity of concepts presented in multimedia package

No.	Items	Agree	Undecided	Disagree	II
1	Concepts were clarified properly.	29 (90.62%)	2 (6.25%)	1 (3.12%)	2.87
2	Examples given in the multimedia package were helpful in conceptual clarity.	27 (84.37%)	3 (9.37%)	2 (6.25%)	2.78
3	Teaching points given under each unit were logically sequenced.	30 (93.74%)	2 (6.25%)	- (0 %)	2.94
4	Demonstrations shown in the multimedia package were clear.	30 (93.74%)	2 (6.25%)	- (0 %)	2.94
	Average				2.88

From the data provided in Table 3, it is evident that the average intensity index was 2.88 for the statements related to the clarity of the content presented. This suggests that the examples were helpful, the teaching points were logically sequenced, and demonstrations were relevant. Consequently, student-teachers found the content to be more comprehensive. Therefore, it can be concluded that "The multimedia package aided in clarifying the concepts presented to the students." One possible explanation for this is the effective organization of teaching points. The examples provided under the

multimedia package were tailored to the student-teachers' level and understanding. Additionally, the videos included in the package were useful in clarifying concepts. Overall, the multimedia package was effective in meeting the needs of all types of students.

Table 4
Reaction of student-teachers on comprehensiveness of multimedia package

No.	Items	Agree	Undecided	Disagree	II
1	Content covered under each unit of multimedia package was sufficient.	25 (78.12%)	5 (15.62%)	2 (6.25%)	2.72
2	Examples provided in the multimedia package were adequate for the purpose.	26 (81.25%)	5 (15.62%)	1 (3.12%)	2.78
3	Pictures given in the multimedia package were relevant to the topic.	30 (93.74%)	2 (6.25%)	- (0 %)	2.94
4	The multimedia package covered all the relevant topics.	24 (74.99%)	5 (15.62%)	2 (9.37%)	2.65
	Average				2.88

Table 4 shows the average intensity index was 2.88 for the statements related to the understanding of the multimedia package, including content covered under each unit, illustrations with examples, and relevance of the content. This suggests that the covered content is adequate and relevant. One possible explanation for this could be the clear comprehension of the requirements of student teachers for effective learning using technology. In addition, the educational value of contemporary technology and its applications in classrooms were examined. The topics and content offer a comprehensive perspective and understanding of the integration of ICT in teaching and learning processes.

Table 5
Reaction of student-teachers with respect to ICT skill development through multimedia package

No.	Items	Agree	Undecided	Disagree	II
1	Learning through package developed ICT skills.	29 (90.62%)	1 (3.12%)	2 (6.25%)	2.84
2	Learning experience provided through multimedia package assisted in developing creativity.	24 (74.99%)	5 (15.62%)	3 (9.37%)	2.65
3	Learning through multimedia package was helpful in developing skills of information management.	27 (84.37%)	4 (12.5%)	1 (3.12%)	2.81
4	Media Exposure provided through multimedia package facilitated the development of skills of media designing.	26 (81.25%)	6 (18.75%)	- (0%)	2.81
5	Interaction and learning through multimedia package helped in developing skills of collaboration and communication.	28 (87.50%)	3 (9.37%)	1 (3.12%)	2.84
6	Learning environment provided through multimedia package aided in developing techno pedagogical skills.	29 (90.62%)	3 (9.37%)	- (0%)	2.90
7	Learning exposure provided through multimedia package helped in developing the skill for creating a web-enhanced learning environment.	26 (81.24%)	5 (15.62%)	1 (3.12%)	2.78
	Average				2.81

The Multimedia Package, which comprises various components, can be utilized to improve ICT skills. The researchers sought to determine the extent to which the Multimedia Package was effective in enhancing these skills. A reaction scale assessing overall ICT skill development, creativity, information management, media design, collaboration and communication, techno-pedagogical skills, and web-enhanced learning environment skills was administered to the student-teachers. The collected data were then analyzed. From Table 5, it is evident that the average intensity index was 2.81 for statements concerning skill development through multimedia. This indicates that the Multimedia Package is useful for developing various ICT skills. The multimedia package provided sufficient examples for student-teachers to comprehend the use and application of ICT in education. Activities based on multimedia presentations offer ample scope for developing skills related to incorporating technology in classroom teaching. It can be concluded that practical exposure to and understanding of ICT and its applications were adequately considered while developing the multimedia presentation, leading to the enhancement of ICT skills. Additionally, multimedia

satisfies the prerequisites for developing technical skills, thereby facilitating a comprehensive understanding and application of ICT in education.

Table 6

Reaction of student-teachers with respect to the usability of the multimedia package

No.	Items	Agree	Undecided	Disagree	II
1	The examples provided in the package were easy to understand.	29 (28.12%)	2 (6.25%)	1 (3.12%)	2.88
2	Instructions given in the learning resources were clear.	28 (40.62%)	4 (12.5%)	- (0 %)	2.88
3	The instructional manual contained all the information about the multimedia package.	25 (31.25%)	6 (18.75%)	1 (3.12%)	2.75
4	The Multimedia package was user-friendly.	30 (25%)	2 (6.25%)	- (0 %)	2.94
	Average				2.86

According to Table 6, the average intensity index of 2.86 indicates that the examples provided in the multimedia package were easily understandable and clear, and students found this approach to be interesting. The simplicity and learning experiences provided by multimedia packages enhance usability in future classrooms. Student-teachers can explore their learning experiences and understanding of ICT in education in future classrooms, and learning can be made interesting through multimedia. Moreover, the manual provided along with the multimedia program increased the usability of the multimedia package.

Table 7

Reaction of student-teachers with respect to utility of the multimedia package

No.	Items	Agree	Undecided	Disagree	II
1	The learning material provided helped in self-learning.	28 (87.49%)	2 (6.25%)	2 (6.25%)	2.81
2	Teaching strategy given was useful in providing practical experience.	29 (90.62%)	1 (3.12%)	2 (6.25%)	2.84
3	Multimedia package helped in the understanding of the concepts.	30 (93.75%)	1 (3.12%)	1 (3.12%)	2.91
4	Learning through multimedia package was very interesting as due to hands-on experiences.	26 (81.24%)	5 (15.62%)	1 (3.12%)	2.78
5	Multimedia package was helpful for planning a digital lesson plan.	29 (90.62%)	1 (3.12%)	2 (6.25%)	2.84
	Average				2.84

Table 7's statements elicited favorable responses from student-teachers, demonstrating their preference for the practicality of the multimedia package. Student-teachers expressed strong agreement with the educational value of the learning materials and their suitability for self-study. The package offered useful strategies that provided practical exposure, enabling student-teachers to plan a digital lesson effectively. The multimedia package was supplied in the form of a CD-ROM, which adds to its usefulness. The Adobe Acrobat software was utilized to create the multimedia package

and ensure compatibility with all devices using the Adobe Reader. The science lesson plans, which served as examples of the multimedia-based approach, provided practical value for the science classroom's multimedia-based approach. The software required to run the package and other necessary software for practice made the learning resource flexible and user-friendly, enhancing its value as a self-learning tool. The multimedia packege facilitated flexible and self-directed learning, thereby promoting a solid understanding of information and communication technology.

DISCUSSION

The first finding emerging from the study is that the development of the multimedia package proved to be effective in enhancing academic performance in ICT in education course as compared to the conventional approach. This finding aligns with the findings reported by several researchers studying the effectiveness of multimedia packages for learning concepts and ideas (Irudayam, 2015; Komalasari & Rahmat, 2019;, Nakpong & Chanchalor, 2019; Indira, 2020; Kumar, 2020; Nachimuthu & Sasi, 2021; Kaur et al., 2022; Dhivya,et, al., 2023). Moreover, Tiwari (2021), Jeya & Saravanakumar (2022),and Kumar & Ramani (2022) indicated a notable difference between the performance of student teachers in the control and experimental groups in the achievement tests. Therefore, it can be argued that a significant difference in the post-test demonstrates that the multimedia approach assists teachers in teaching effectively in the classroom. Additionally, the findings of the study conducted by Shukla (2017), Vadivel et al. (2019), and Terentyeva et al. (2019) demonstrated that multimedia courseware was found to be effective at the undergraduate and postgraduate level with significant improvements in attention, response, and recall of content. The results of various studies indicate that the multimedia package was useful in terms of developing an understanding of the concepts presented using constructivist instructional design. It is worth reporting that the multimedia approach with various combinations is effective for teaching students, particularly novice learners.

CONCLUSION

With the increasing role of technology in all aspects of life, multimedia plays a vital role in enhancing the ICT skills needed. The study has shown empirically that multimedia packages can prove highly effective for ICT in education. Pre-service student-teachers can benefit from multimedia-based training to meet the needs of 21st-century learners. The study also supports that these packages should prioritize simplicity, flexibility, adequacy, practical examples, exposure, and self-learning to engage learners effectively. Thus, it can serve as a supplementary tool for teacher educators to enhance ICT skills and as instructional support.

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