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Exploring the Educational Frontier: Unveiling the Dynamics of Computer Assisted Instruction (CAI) in Contrast to Traditional Teaching

* Dr. Sumaera Mehmood, Assistant Professor (Corresponding Author)

** Dr. Muhammad Mushtaq, Dean Arts & Social Sciences

*** Dr. Fatima Muhammad Qasim, Assistant Professor

Abstract

The study investigates the differences between traditional teaching methods and computer-assisted instruction (CAI). The goals of the study were to examine how computer-assisted instruction affects secondary school pupils' academic achievement in general science, to ascertain how traditional teaching approaches affect secondary school pupils' academic achievement in the general science course, to ascertain how traditional teaching approaches affect secondary school pupils' academic achievement in the general science course, to evaluate the impact of both traditional and CAI instruction on students' academic achievement in the General Science course; to propose recommendations based on the results of the current study for General Science educators, students, administrators, teacher trainers, and policy makers. Based on the research questions, we formulated four null hypotheses. We employed the nonequivalent control group design as one type of quasi-experimental design. We selected a random sample of two intact sections of 10th grade, totaling sixty-four students studying General Science, and conducted the experiment over ten academic weeks. We collected pre-test and post-test data on academic achievement. We used the conventional lecture format to instruct the control group. We addressed research and hypothesis questions using summary statistics and paired t-tests. The results of the study exhibited that CAI outperformed the traditional lecture method. The results of the present study provided much-needed motivation to use CAI and improve students' academic performance. Animated videos and images make science concepts easily understandable. The animated videos and images capture the students' attention, enhancing their focus during the teaching and learning process. Computer-assisted instruction is beneficial for slow learners or especially ADHD students. The attractive colors in the diagrams helped them to focus their attention on the teaching and learning process and make this process more enjoyable.

Keywords: Computer Assisted Instruction, Traditional Teaching, Academic Performance, Teaching Methods

Introduction

Schools around the world widely use computers and other related technology. Every educational institution has seen the progress made by these technologies. The majority of developed countries have equipped their educational institutions with computers and internet access, leading to a decline in the use of paper textbooks.

These technologies, along with other disciplines, integrate and influence each other. Many educators are familiar with and use technology, and it has changed processes, concepts, and the fundamentals of discipline. We encourage learners to use computers as a teaching tool. The 1950s saw a partial introduction of computers, whereas the 1980s saw their full introduction. On the other hand, IBM created the first written language and Computer Assisted Instruction (CAI). This program required students to follow instructions displayed on a computer screen and answer questions based on behaviorist education theories. The University of Illinois was responsible for implementing the first major project. Atkinson, R.C. & Suppes, P. (1959) research provided guidelines for computer application use at the university and school levels in the 1960s. Microcomputers attracted many educators due to their affordability, portability, and wide range of features, setting them apart from older computers.

* Institute of Education & Research, MY University Islamabad Email: Sumaera_25@hotmail.com
** Women University of Bagh Kashmir
*** Institute of Education & Research, MY University Islamabad

The widespread use of computer-based training led to the creation of a large amount of educational software based on the types of exercises and drills. The Skinner method of branching, which divides into discrete areas and combines reactions and distinct facts, served as the foundation for these instructional software programs. It appeared that the students were unable to solve the difficulties on their own, and that the learning process was passive. Previous research has shown that learners benefit more from technology when it is objective. The technological breakthroughs in the latter decade of the 20th century have revolutionized teaching methods. Students who use technology improve their problem-solving and problem-building skills because they are more self-reliant. According to ncrel.org (2003), although cognitive domain instructional technology emphasizes "looking at how we know rather than how we respond and analyzing how we plan and strategize our thinking, remembering, understanding, and communicating," this is not how things actually operate in practice. Furthermore, studies have shown that formatting programs like word processors benefit educators and students by simplifying the removal, editing, and rewriting of written materials. When education experts learned how computers' various characteristics helped to create a productive learning environment, they too started to see the importance of using computers as instruments for research. These features include spreadsheets and simple presentations. We can leverage the significant advancements in technology and internet speed to achieve educational goals (Reiser, 2001).

According to cognitive schools of thought, learners use this medium to play games and use simulation techniques to gain knowledge and skills. By exchanging ideas with one another through networks and communication, students gain more knowledge and information. Additionally, learning remotely and online has expanded the learner's chances for appropriate and flexible instruction. According to Kalu (2006), 51% of students in 1998 had Internet access in the classroom, and 93% in 2003. Technological developments aid in the manipulation and expression of conceptual explanations, which can lead to the creation of innovative and creative learning environments.

The terms Computer-Based Education (CBE) and Computer-Based Instruction (CBI) reflect the use of any kind of computer to accomplish educational objectives, such as programming, tutorials, simulation exercises, etc. These words refer to the use of computer-based learning activities to improve educational outcomes and help students retain the information that teachers have imparted.

To provide learners with access to a variety of knowledge and details during the learning and teaching process, or as an extra source, CAI places a strong emphasis on the use of computer applications. Papert (1993) stated that computer programs administer exercises traditionally given by teachers using worksheets, blackboards, or textbooks. In the past twenty years, technology has changed dramatically and quickly, but for a different reason, both teachers and students have continued to use CAI. Computer-assisted learning activities such as practice, simulation, and drill helped learners improve their skills and increase the efficiency with which they could complete a task.

Teachers frequently used this pattern to teach language, math, vocabulary, and translation. These apps give students multiple chances to try before providing the correct answer. In the tutorial application, students utilize various methods to arrive at solutions as they appear. On the other hand, learners have the opportunity to inquire about and engage in programming through exploratory applications.

Additionally, it teaches students to reason logically. Setzer and Monke (2001) state that simulation is a different type of software in which students explore the computer screen. Both in the field and in the research center, students observe and engage with simulations. Ecosystems and simulation laid the foundation for well-known 90s concepts, allowing students to manipulate the environment's characteristics and draw conclusions from their observations and play.

Tutorial mode is another program that may serve as an instructor. By including a variety of exercises and questions, it served as a tool for teaching students and improving their comprehension. We used computers to analyze the replies and suggest solutions based on those answers. Smaldino, Russell, Heinich, & Molenda (2005) suggest that "Mavis Beacon Teachers Typing" can help attain touch typing proficiency. "An activity where participants adhere to guidelines that are different from those found in real life," according to Smaldino et al. (2005) Even if games lack fundamental instructional qualities, they are still considered educational games because they help to retain pedagogical concepts. The gaming program motivates pupils and instills a competitive spirit while they engage in educational activities. The students assess their knowledge and grasp of the concepts

and information they have studied by comparing their past scores with their current scores. The qualities they get from playing games support their capacity to learn, manage time, and increase speed. Smaldino et al. (2005), for example, claim that the magic castle learning game's core was the capacity for problem-solving via enjoyment.

Robertson (2004) asserts that the educational setup can also incorporate other tactics like problem solving and exploration, in addition to the widely used CAI learning mediums. In the future, computers will not only aid researchers but also foster efficient education. With the advent of the internet in the 1990s, there was a strong push for virtual and online learning, distant learning, e-books, and e-learning, all of which would have enormous potential in the years to come.

The main goal is to assist all novices in making the most of their education. The figure displays a few program categories that are offered by CAI.

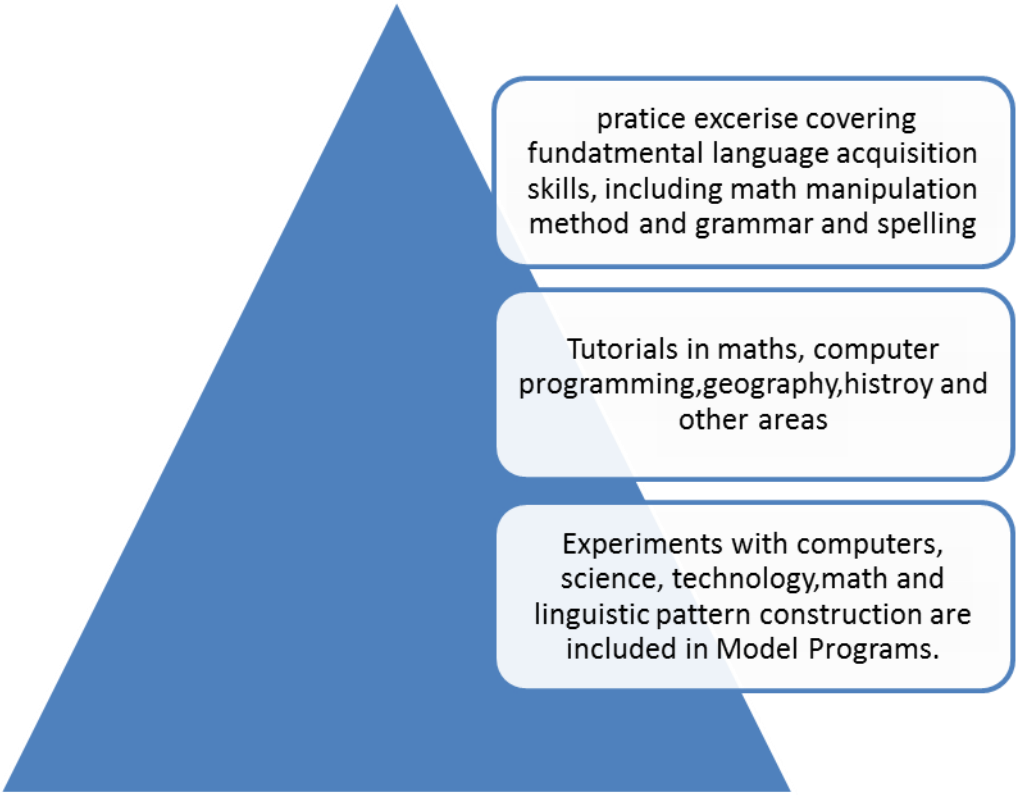

Figure 1: Categories of Programs

Change the spelling in dictionaries and grammar, conduct experiments, and develop programs. CAI includes a variety of characteristics associated with learner-controlled instruction, such as topic commentary, self-directed learning, adaptability to instruction, and receptivity to learning in the current technological environment. According to Theroux (2002) and Johnson & Johnson (1991), in traditional learning, the teacher has the primary role and controls the learning process because he is the source of instruction. He typically chooses the content for instruction, which aligns with the curriculum, and imparts information to the students. In summary, they believe that learning occurs solely due to the teacher's influence and has no connection to the classroom or other environments. The delivery of content holds significant importance. We should absorb learning material contextually, acquiring information through practice, drill, and exercise. The word lecture originates from the Latin word lectus, which means to read. This word originally described reading, but after the 16th century, it also described the spoken teaching that a teacher gave to his students.

The teacher now uses the lecture method to provide oral presentations to his students. These presentations may also incorporate audio-visual aids. The widespread use of technology has made teaching easier for teachers, since, unlike in the past, they can now employ videos, slides, and visuals to enhance student learning instead of just using chalk and blackboards. Science classes typically employ the lecture approach. Because teachers have a significant impact on the classroom, it is a teacher-controlled strategy. It is also an information-cantered strategy because it emphasizes specific knowledge over student comprehension. The teacher is the only one who can provide instruction. Students play a passive role, paying attention to the teacher.

Literature Review

There are several techniques for improving and enhancing learning through the lecture approach. The following graphic depicts the various lecture methods. When a topic seems to fit into a particular type of treatment, instructors may choose to use approaches with which they are not familiar. Consequently, they choose the most effective lecture technique, which adds variety for both educators and learners.

Numerous studies have demonstrated the importance of the lecture method. These encompass introducing fresh perspectives, integrating crucial elements, accurately defining the goal, delineating the framework, showcasing the significance of knowledge, compressing the educational path, fostering curiosity, enthusiasm, and flexibility in a task-oriented learning setting, all under the guidance of a seasoned instructor in a workshop. The learning environment must be considered when teaching, and students' responses should provide varying models of learning and critical thinking. Ebenzer S.O. Collier (2004) asserts that the instructor's instruction using CAI yields more effective results than instruction without it.

A computer is useful for a variety of tasks. Through games, tutorials, text reading, tracing practice, and modeling lab experiments, students can use it to enhance their skills. Computer-assisted instruction could be extremely powerful and conspicuous in lab work and classroom settings. Instead of replacing other tasks, it can serve as an additional tool.

Cuco and Goldenberg (1996) found that in mathematics, the CAI can support the growth of the learner's capacity for greater conceptualization, creativity, and diversity in the creation of visual results. Students who can independently change formulas, variables, and models using CAI-based tools comprehend and apply concepts significantly better than those who learn these concepts through lectures. Because CAI uses a variety of senses, Bergman and Cheney (1996) discovered that it fosters the learner's knowledge. When audiovisual aids, movies, and other text forms are part of the curriculum, students can absorb and retain the information much more easily.

In 1996, a comparative study on frog dissection in a traditional lab revealed that the use of CAI simulation made users happier than carrying out the experiment. Users were pleased that they could improve their ability to back up, fix, and correct their mistakes, as well as their ability to independently explore the dissection and branch out of the instructions.

They were also pleased that the dissection didn't require an actual animal (Kinzie, Larsen, Burch, & Boker, 1996). When using CAI as a tutor, it is imperative that students engage with one another during the learning process. According to Scott D. Lipscomb (2004), students can use hypertext and hyperlinking to present in their own order while staying within the parameters specified by the instructor or coder. McCormack & Jones (1998) assert that maintaining human connection in an online teaching-learning environment is crucial, and they emphasize the importance of CAI. Engaging with the teacher and one another enhances critical thinking skills and enhances learning. Chabay & Sherwood (1992, p. 154) state that one important benefit of CAI is that it necessitates student participation in the learning process. Not only is it possible, but it is essential that students connect with the computer; otherwise, nothing will happen. Lockard, Abrams, & Many (1987, p. 144) state that in order for pupils to navigate from one information screen to the next, they must utilize the computer's peripheral hardware, such as a joystick, mouse, and other devices. As a result, students cannot assume the role of simple observers when using CAI. According to Brooks (1997), students have a more fruitful and successful learning experience when the instructor uses structured case-based instruction (CAI) within the course and when the teacher still meets with his students in a conventional manner. This can be advantageous for the students because it allows them to interact with the faculty and one another in traditional classroom settings.

Traditional classrooms provide lessons in a linear format with minimal to no interaction between the teacher and students. Students can readily obtain the CAI materials ahead of time, which can help save time in the classroom. Additionally, the instructor can mentor students and include them in a variety of activities, such as intellectual conversations about various subjects and peer interaction. Instead of delivering lecture topics in a linear fashion, the instructor should use creative teaching tactics, according to Porter (1997). According to Kommers (1996), on page 18, using CAI to deliver lectures instead of traditional methods can save time and benefit students, instructors, and the university in various ways. With the extra time, the teacher may, for instance, implement learner-based activities and motivate students to interact with both the faculty and one another. Bergman and

Cheney (1996) claim that while CRL is more cost-effective than CAI, the vast user base has the ability to gradually modify the cost. According to Bui (1999, p. 14), the CAI for a few cases shows less funding for things like science research labs and resident teaching.

Therefore, it is essential to make the best use of the available resources, lower the cost of producing CAI, and still meet the learning objectives. The current study's purpose is to determine how CAI affects conventional secondary general science instruction.

Statement of the Problem

This research project sought to determine how secondary students' academic performance was affected by computer-assisted instruction (CAI) as opposed to traditional classroom education, with a particular emphasis on general science subjects.

Objectives

The following were the study's objectives:

I. To find out how computer-assisted instruction affects secondary school pupils' academic achievement in general science;
II. To ascertain how traditional teaching approaches affect secondary school pupils' academic achievement in the general science course;
III. To ascertain how traditional teaching approaches affect secondary school pupils' academic achievement in the general science course;
IV. To evaluate the impact of both traditional and CAI instruction on students' academic achievement in the General Science course;
V. To propose recommendations based on the results of the current study for General Science educators, students, administrators, teacher trainers, and policy makers.

Hypotheses

The following null hypotheses were formulated:

H_1: The experimental group's and the control group's mean pre-test scores do not differ significantly;
H_2: The experimental group's and the control group's mean post-test scores do not differ significantly;
H_3: The experimental group's mean pre-test and post-test scores do not differ significantly.
H_4: The control group's mean pre-test and post-test scores do not differ significantly.

Delimitations of the Study

This study was delimited to

- Subject of General Science
- F.G Girls Secondary Schools situated in Rawalpindi City.
- Students of 10th grade, studying in morning shift.

Rational of The Study

The study's conclusions might be considered noteworthy by several stakeholders. The first group consisted of policy makers responsible for providing policy guidance. Curriculum designers, textbook authors, teacher trainers, and assessors collaborate to enhance the curriculum's overall structure. The task of creating curriculum planners fell to the second group. Choose robust curricular materials that effectively address the emerging difficulties, followed by a suitable textbook. Authors are responsible for producing educational material that demonstrates a significant improvement in content and writing style. The distribution technique includes interactive processes, graphs, visual pictures, and in-depth treatment. Coherence is an essential element that binds together the learning process and the development of strong connections.

The third group established themselves. Teachers and educators should use a variety of methods to effectively communicate their lessons in the classroom. They should focus on instruction and education, conduct empirical investigations, implement data-driven instruction, and encourage students' growth by collecting investments.

The researcher designated the evaluator group as the last group, with a particular emphasis on process assessment. Instead of seeking conventional solutions, the redesigned patterns may serve as the foundation for constructing all the levels. Regarding Bloom's taxonomy of knowledge, therefore, the conceptual shift would result in the enhancement of students' learning in the subject of science. Individuals with mild and moderate learning difficulties may benefit from enhanced scientific literacy abilities. Through their practical application, we can improve our scientific literacy skills and cultivate

a deeper understanding of scientific concepts. Helping educators maintain student engagement by actively involving them on a regular basis would be beneficial. People who are inattentive, introverted, and possess unique learning needs require assistance. The results of this study Studying this topic would be very valuable for future scholars who want to compare their findings in other regions.

Research Methodology

This project involved two distinct phases: the development of Microsoft Power Point presentations for computer-based instruction. The evaluation of pupils' academic performance combined traditional teaching methods with CAI experimentation. We employed the nonequivalent control group design because we selected two entire classes as a sample. The nonequivalent control group design. This design administers pre- and post-tests to the two randomly selected groups, both before and after the investigation. The study population consisted of all the female students enrolled in the tenth grade at the twelve F.G. Girls Secondary Schools in Rawalpindi City. We randomly selected a single school to conduct the experiment. In total, the sample consisted of sixty-four students. We placed thirty-two students in the experimental group, where they received instruction via CAI, and another thirty-two students in the control group, where they received instruction using conventional methods.

The researcher employed the pre- and post-test methods of a 51-item self-prepared accomplishment test. The researcher created these materials by incorporating the three lessons from the tenth-grade textbook. We examined the data using the paired sample t test, t test, and mean standard deviation. This study used pre-tests to measure academic achievement prior to the experiment and post-tests to measure achievement after the experiment. Female students in the tenth grade at Rawalpindi City's F.G. Girls School participated in the experiment. The trial took place in 2014, between April and June. Teaching took place for forty-five minutes a day, four days a week, Monday through Thursday. Every group's teacher possessed identical academic and professional credentials, such as an M.Phil. in education. The researcher selected a General Science textbook from NBF and recommended using FBISE's SSC II for the course material. We created just three chapters, "Environment and Natural Resources, Science and Technology, and Man and Health," using Microsoft PowerPoint 2010 to conduct the experiment.

Conceptual framework of CAI

The conceptual framework for CAI and PowerPoint presentation was used as a tool for active delivery of lecture. Selected textbook material was converted into slides with animated pictures and use of some videos. Which make the text material more attractive and easier to understandable for students. Control group was taught with the traditional methods and after conducting post test the result was compared.

Results of the Study

Table No 1

Significant Disparity between the CAI and Traditional Teaching Group Mean Pretest Scores

Groups	N	Mean	Std. Deviation	t	p value
Pre CAI	32	17.18	2.86	-2.83	>.008
Pre Traditional Teaching	32	19.00	3.2		

df =62 t at .05 =1.994

The mean pre-test scores for academic achievement in both the CAI and traditional teaching methods are displayed in the above table. The table's data demonstrate that there was a substantial difference in the mean academic achievement scores between the pre-traditional teaching test (19.0) and the pre-CAI (17.15). At 0.05 level, the t-value (t=-2.84) is greater than the p-value. Ho1 is hence rejected.

Table No 2

Significant Disparity between CAI and Traditional Teaching Mean Posttest Scores

Groups	N	Mean	SD	t	p
CAI	32	31.0	3.68	7.75	>0.001
Traditional Teaching	32	22.15	5.3		

df=62 t at 0.05= 1.994

The mean post-test results for the two comparison groups—traditional instruction and CAI—are displayed in the above table. The table's results demonstrate that there was a significant difference

between the traditional group's post-mean score of 22.15 and the CAI group's post-mean score of 31.0. At the 0.05 level, the t value of 7.75 is more than the p value. As a result, Ho is disproved, and we draw the conclusion that the two groups differ significantly.

Table No 3

Significance of the Difference in the Computer Assisted Group's Mean Pretest and Posttest Scores

Groups	N	Mean	SD	T	p value
Pretest	32	17.18	2.8	19.14	>.000
Posttest	32	31.50	3.6		

df =32 t at .05 =2.021

The mean academic achievement scores of the computer assisted instruction group are displayed in the above table for both the pre- and post-tests. The paired sample t-value (t=19.14) is higher than the p value at the 0.05 level, indicating that there was a significant difference in the mean academic achievement scores of computer assisted instruction between the pre-test (17.18) and post-test (31.50 out of 51). Thus, the third null hypothesis was disproved. It suggests that as a result of CAI, the CAI group also greatly improved their achievement from the pretest to the posttest.

Table No.5

Significance of the Variation in the Traditional Teaching Group's Mean Pretest and Posttest Scores

Groups	N	Mean	SD	t	p value
Pretest	32	19.78	4.5	2.14	>.04
Posttest	32	22.15	5.3		

df =31 t at .05 =2.021

The academic accomplishment scores of the traditional instruction group before and after the test are displayed in the above table. Given that the paired sample t-value (t=2.14) is higher than the p value at the 0.05 level, the table's results demonstrate a significant difference between the mean pre-test (19.78) and post-test (22.15 out of 51) academic accomplishment scores of the traditional teaching approach. This indicated that the fourth null hypothesis was disproved. Additionally, it suggests that while the traditional teaching group did not achieve as much as the reciprocal teaching group and CAI, they still made substantial progress.

Discussions

The current study's findings showed that, in comparison to traditional teaching methods, computer-aided instruction (CAI) was more successful in teaching general science topics. This result is in line with what Barakter, M. (2000), . Mahmood, P. (2004), and Miller, (1999), found. Miller, Mintaz, and Campbell (2000), Mintz (2000), and Campbell (2000) conducted research that compared traditional education with the use of CAI in reading and mathematics instruction at the elementary school level. Training students with CAI significantly influenced their critical thinking abilities differently than training them with conventional methods. Mahmood (2004) studied the relationship between the traditional manner of instruction and CAI. In contrast to traditional teaching methods, this study looked at how computer-assisted instruction affected the progress of general science students. The outcomes showed that the experimental group outperformed the control group in every performance category, including levels of cognitive domain, content type, and overall performance. Students love and benefit from the CAI curriculum. They believed it to be a more successful teaching method than the traditional one. Barakter (2000) used a meta-analysis research approach to create a study, which Mahmood (2004) mentioned. The aim of this research is to investigate the potential effects of computer-assisted instruction (CAI) on secondary and college science students' performance. It also seeks to determine whether certain initiatives or studies have any bearing on the efficacy of CAI. This meta-analysis included 42 studies that compared computer-assisted learning to traditional learning. The standard deviation of 0.273 indicates that CAI has a barely beneficial effect on students' performance in science classes at the secondary and college levels. When a typical student receives instruction using CAI, their performance is 62% higher than when they receive instruction through traditional means. Mintz (2000) and Campbell (2000) conducted a comparison between CAI and standard education in basic math and reading, as cited by Mahmood (2004). Students who received instruction through CAI demonstrated significantly different critical thinking skills from those who did not.

Miller (1999) carried out a qualitative study to confirm that CAI instruction is successful for Intermediate Algebra courses, as stated by Mahmood (2004). The main takeaway from this study

about CAI is the benefits that students receive from instantaneous computer feedback, the significance of interactive mathematics learning, and the advantages of one-on-one training. The study's findings also demonstrate that using computers in conjunction with their training enhances the academic performance of tenth-grade general science students. When compared to CAI, traditional teaching is not as successful. As a result, CAI produced improved outcomes and increased student engagement.

Conclusions

The following conclusions were made considering the study's findings and statistical analysis of the data.

1 In the topic of general science, computer-assisted instruction outperformed traditional teaching methods in terms of raising the average academic achievement of female students in the tenth grade.

2 When it came to general science student accomplishment, traditional teaching methods had the least impact.

3 Animated videos and images make science concepts easy to understand. It catches the students' attention, and they become more focused during the teaching and learning process.

4 Computer-assisted instruction is beneficial for slow learners or especially ADHD students. The attractive colors in the diagrams helped them focus their attention on the teaching and learning process and make this process more enjoyable.

Recommendations

1 Education departments and colleges at universities that train future teachers through pre-service training should develop rigorous curricula using cutting-edge techniques and give CAI, microteaching, and related strategic elements enough weight to build up in their regular training programs with rigor.

2 This investigation was experimental and conducted in a constrained setting. Expanding the study to cover more themes within the subject or across subjects for a variety of populations and locations around the nation could validate the findings and promote their generalizability. Furthermore, comprehensive studies in CAI using standardized tests and focusing on high achievers, medium learners, and slow learners, both individually and collectively, may yield additional proof in favor of a more varied approach to treatment. This lays the groundwork for future research. For ten weeks, the ongoing study focused on three chapters of modern science. Further research may lengthen the exam's time and text content.

3 The government can provide sufficient funding to train educators in updated multimedia courses like CAI in order to improve the current situation.

4 We may introduce programs for pre-service and regular in-service training. We introduce at least two in-service training programs in a single year to equip teachers with the most recent teaching pedagogy.

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