EFFECT OF COMPUTER AIDED INSTRUCTION ON STUDENTS' PROCEDURAL AND CONCEPTUAL UNDERSTANDING OF ALGEBRAIC EXPRESSIONS IN ENUGU STATE

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Abstract

This study investigated the effect of computer aided instruction on secondary schools students' procedural and conceptual understanding of Algebraic expressions in Enugu state. Quasi experimental research design was adopted in this study. Specifically, it a pretest-posttest non randomized control group design. Four research questions and six hypotheses guided the study. The study was conducted in Enugu State, where a sample of 664 Senior Secondary Two (SS2) students was drawn from sixteen intact classes in the four public and four private secondary schools randomly drawn using simple random sampling techniques. Instruments used for data collection were Algebra Procedural Understanding Test (APUT) and Algebra Conceptual Understanding Test (ACUT). APUT and ACUT were made up of 20 and 22 multiple choice questions respectively. The questions were drawn using appropriate Test Blueprints. The instruments were constructed by the researcher and validated by three research experts. Reliability coefficients obtained for APUT and ACUT were .86 and .91 respectively. Kudar Richardson formula 20 (KR-20) was used for reliability analyses. Mean and standard deviation were used to answer the research questions while hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA). Major findings of the study showed that secondary school students taught algebra with CAI gained more procedural and conceptual understanding of algebraic expressions than their counterparts who were taught same topics without CAI. It was recommended among others that use of CAI for teaching secondary school algebra should be adopted by all public and private secondary schools in Enugu State.

Introduction

Secondary school mathematics curriculum covers so many topics such as geometry, trigonometry, statistics, commercial arithmetic and algebra. Agbenyi (2020) hinted that Algebra consists over 46 percent of secondary school mathematics curriculum content in Nigeria. Algebra (from Arabic al-jebr meaning "reunion of broken parts") is the branch of mathematics concerned with the study of the rules of operations and relations, and the constructions and concepts arising from them, including terms, polynomials, equations and algebraic structures. Together with geometry, real analysis, topology, combinatiorics, and number theory, algebra is one of the main branches of pure mathematics. Kofi (2021) stated defined algebra as the part of mathematics in which letters and other general symbols are used to represent numbers and quantities in formulae and equations. Letter and symbols used to represent numbers and quantities, in formulae and equations are usually called "unknowns".

Algebra may therefore, be defined as a system of representing numbers and quantities with unknowns in equations based on given axioms. Damte (2021) observed that elementary algebra, often part of the curriculum in secondary education, introduces the concept of variables representing numbers. Statements based on these variables are manipulated using the rules of operations that apply to numbers, such as addition. This can be done for a variety of reasons, including equation solving. However, Algebra is much broader than elementary algebra and studies what happens when different rules of operations are used and when operations are devised for things other than numbers. Addition and multiplication can be generalized and their precise definitions lead to structures such as groups, rings and fields, studied in the area of mathematics called abstract algebra. Husseini (2021) narrated that by the time of Plato, Greek mathematics had undergone a drastic change.

The Greeks created a geometric algebra where terms were represented by sides of geometric objects, usually lines, that had letters associated with them. According to Husseini, secondary education algebra mainly introduces the concepts of variables representing numbers. Statements based on these variables are manipulated using the rules of operations that apply to numbers. Algebra do not only deal with properties of numbers but also reveals how those properties can be applied in solving day to day practical life problems. Hence, good skills and competences in algebra is a great asset to any secondary school student because it is a tool for developing critical and logical thinking that can facilitate the learning of other branches of mathematics and even other secondary school subjects. However, Akan (2021) noted that useful algebraic skills and competences must derive from good understanding of both procedural and conceptual algebraic processes

A student's procedural understanding of algebra refers to their ability to comprehend and correctly apply the rules, steps, and methods involved in solving algebraic problems. According to Akan, procedural understanding goes beyond simply memorizing formulas or following instructions rather, it involves knowing how each step works and being able to use those steps accurately, efficiently, and flexibly. For example, when solving an equation like $2x+5=112x + 5 = 11$, a student with strong procedural understanding not only knows to subtract 5 and then divide by 2 but also understands that these actions maintain the balance of the equation. Bell (2022) averred that many students perform well on routine algebraic exercises but struggle when faced with non-routine or multi-step problems. This is because such students often treat algebra as a set of mechanical symbol manipulations rather than a meaningful process.

Students who lack procedural understanding may rely heavily on memorized steps, which can fail them when problems are presented in unfamiliar ways. Procedural understanding is usually referred to as (the how something works). To strengthen students' procedural understanding of algebra, mathematics teachers can provide step-by-step practice while also encouraging students to reflect on why each step is necessary. Activities such as analyzing errors, solving problems in multiple ways, and connecting procedures to real-life contexts help deepen understanding. Encouraging students to ask themselves whether their answers make sense also builds metacognitive awareness, which is crucial for long-term success in algebra. Summarily, procedural understanding in algebra is about mastering the steps of problem-solving with accuracy. It equips students to move beyond rote memorization, enabling them to approach algebra flexibly, justify their reasoning, and apply their knowledge to both familiar and unfamiliar problems.

A student's conceptual understanding of algebra refers to their ability to grasp the underlying principles, meanings, and relationships that give algebra its structure. Unlike procedural knowledge, which focuses on carrying out steps, conceptual understanding emphasizes knowing *why* those steps work and how different ideas in algebra connect. For example, a student with strong conceptual understanding does not just solve 2x+3=72x + 3 = 7; they recognize that the equation represents a balance, that variables stand for unknowns, and that operations can be reversed to maintain equality. Terry (2022) alleged that many students often rely on memorized formulas and algorithms without fully understanding them. This can allow them to manipulate symbols correctly in some cases, but it limits their ability to apply algebra flexibly in new or complex situations. Simply put, students who lack conceptual understanding may only "the how" something works but do not understand "the why" something works. Conceptual understanding unlike like procedural understanding, equips students to interpret algebraic symbols, connect equations to graphs or real-world contexts, and see algebra as a meaningful language of relationships rather than a set of arbitrary rules.

To enhance students' conceptual understanding of algebra, mathematics teachers can focus on linking algebraic procedures to their underlying concepts. This includes using multiple representations such as graphs, tables, and verbal explanations so that students see how the same idea can be expressed in different forms. Eze (2022) added that encouraging students to explain their reasoning, compare solution strategies, and connect algebra to real-life contexts also deepens their comprehension. Practical activities, problem-based learning, and opportunities for students to create their own algebraic models can further enhance understanding. Conceptual understanding of algebra is about seeing algebra as a coherent system of ideas rather than a collection of steps. It allows students to explain, justify, and apply algebraic concepts in flexible ways.

Evidently, procedural and conceptual understanding are necessary for good skills in algebra. Both are complementary. Secondary schools students need good procedural and conceptual understanding of algebraic expressions. When students develop this deeper understanding, they not only perform better in algebra but also build a stronger foundation for advanced mathematics and problem-solving in everyday life. Interestingly, researchers have widely recommended computer aided instruction for enhancement of secondary school students' procedural and conceptual understanding of algebraic expressions. Ajao (2020) defined computer as an electronic device for processing, communicating, and/or storing information. Smith (2021), described a computer as a combination of hardware devices and programs, assembled to accomplish some specific tasks. Computer in its various forms has become an essential part of the learning process.

Two different types of computer use in education were identified by Mark (2021) as class use of computers and supportive use of computers. Class use of computers include computer as tool for presentation, encouraging learners to train skills and instructing learners in the possibilities of computers, while supportive use of computers include administration, preparing work sheet for the learners, looking for information on the internet for lesson preparation. Mark further differentiated between Computer in Education, Computer Education and Computer through Education as follows; Computer in Education is about the use of computer or Information and Communication Technology (ICT) to facilitate education. This involves the application of computer into teaching and learning, from planning through implementation and up to the point of achieving learning objectives. Computer or ICT Education refers to computer or ICT as a subject of study. This requires proper planning for designing and implementing the curriculum that will have a broader perceive of computer from the foundation to all levels of learners.

Computer through Education refers to computer knowledge and skills acquired through education or acquiring computer knowledge and skills through the learning of other subjects. Beech (2022) maintained that the most profitable application of computer in education in contemporary time is the invention of Computer Aided Instruction (CAI). Computer- Aided Instruction (CAI) is the general term used to describe virtually any learning activity that is promoted by computer or in which a computer is involved. Depending upon the relative degree of involvement by the learner, two basic types of CAI were identified by Beech as CAI which involves the use of computer as teaching/ learning aid, but there is no direct involvement by the students. In contrast, interactive CAI promotes active learning in which there are high degree of student's participation and involvement.

Here the students' behaviour and responses to instructional materials can be used to help determine the most appropriate pathway through the body of knowledge coded in the CAI. Use of CAI in teaching and learning of mathematics generally and algebra in particular have produced contradicting results regarding its efficacy in facilitating students' procedural and conceptual understanding of algebraic expressions. Agbenyi (2020) and Bell (2022) found in their separate studies that CAI enhanced students' procedural and conceptual understanding of algebraic processes. Hence, students taught algebra with CAI attained higher procedural and conceptual understanding of algebraic expressions than their counterparts who were taught the same content without CAI. On the other hand Husseini (2021) reported that students who were taught algebra without CAI exhibited better procedural and conceptual understanding than their counterparts who were taught with CAI. Whereas Mark (2021) found no significant difference between the procedural and conceptual understanding of students taught algebra with CAI and those taught algebra without CAI. This no definitive conclusion status suggests the need for more studies. Thus, justifying this present work which aimed at determining the effect of Computer Aided Instruction on secondary school students' procedural and conceptual understanding of algebraic expressions.

Another worrisome by mention to this study is the influence of school type (public/private) on students' procedural and conceptual understanding when taught algebra with CAI. In recent times, school ownership or proprietorship has generated a lot of concern to educators and researchers. School ownership/proprietorship in this work was categorized into two viz; public and private schools. The public schools, also known as state, federal or government schools refer to schools owned, funded and overseen by the state or federal government. The dreaded monster, corruption which has eaten deep into every sector of the Nigerian society has not spared the education sector. Nigerians' general attitudes towards government property suggest that both the grassroot and elite erroneously believe that what belongs to the government belongs to nobody. Hence, Nigerian public schools today are characterized by neglect and abandonment, dilapidated infrastructures, vandalization/ looting of facilities and obsolete teaching aids. Teachers in public schools continue to allege ill-motivation, denial of incentives and poor condition of service. As the teachers resort to hassle for survival, absenteeism and truancy become the order of the day. (Ayuba, 2022).

The story seems not to be in any way better in the private schools. Private schools are schools owned by non-governmental organizations or individuals. Private schools are known for high cost, yet the proprietors seem to shy away from money demanding ventures such as employment of qualified teachers, provision of instructional materials and other infrastructures good for conducive teaching and learning. So many private schools allegedly use secondary school leavers to teach secondary school students, (Adejumo, 2022). Many research evidences that investigated the effect of CAI on public and private secondary schools students' procedural and conceptual understanding of algebra submitted conflicting findings. Haroldi (2020) and Eze (2022) reported that public schools' student taught algebra with CAI attained higher procedural and conceptual understanding than their counterparts in the private schools. Conversely, Ajao (2020) and Kofi (2021), found that private schools' student taught algebra with CAI attained higher procedural and conceptual understanding than their counterparts in the public schools. Meanwhile, Ohanusi (2020) and Akan (2021) found no significant difference between the mean algebra procedural and conceptual scores of public and private secondary school students' taught algebra with CAI. Once more, these conflicting findings justifies the need for this present study. Consequently, the problem of this study put in question form was what is the effect of Computer Aided Instruction on public and private secondary schools students' procedural and conceptual understanding of Algebraic expressions in Enugu state.

Purpose of the Study

The purpose of this study was to investigate the effect of computer aided instruction on secondary schools students' procedural and conceptual understanding of Algebraic expressions in Enugu state. Specifically, the study investigated the effects of computer aided instruction on secondary schools students':

1. Procedural understanding of Algebraic expressions
2. Conceptual understanding of Algebraic expressions
3. Procedural understanding of Algebraic expressions with regard to their school type (public/private)
4. Conceptual understanding of Algebraic expressions with regard to their school type (public/private)

Research Questions

The following research questions guided the study;

1. What are the mean Algebra procedural understanding scores of students in the experimental and control groups in both pretest and posttest?
2. What are the mean Algebra conceptual understanding scores of students in the experimental and control groups in both pretest and posttest?
3. What are the mean Algebra procedural understanding scores of public and private schools' students in the experimental and control groups in both pretest and posttest?
4. What are the mean Algebra conceptual understanding scores of public and private schools' students in the experimental and control groups in both pretest and posttest?

Hypotheses

The following hypotheses were tested at .05 level of significance.

1. There is no significant difference between the mean Algebra procedural understanding scores of the students in experimental and control groups.
2. There is no significant difference between the mean Algebra conceptual understanding scores of the students in experimental and control groups.
3. There is no significant difference between the mean Algebra procedural understanding scores of public and private schools' students in the experimental and control groups.
4. There is no significant difference between the mean Algebra conceptual understanding scores of public and private schools' students in the experimental and control groups.
5. There is no significant interaction between method and school type on students' mean Algebra procedural understanding scores.
6. There is no significant interaction between method and school type on students' mean Algebra conceptual understanding scores.

Methodology

Quasi experimental research design was adopted in this study. Specifically, the researcher adopted a type of experimental design known as pretest-posttest control group design. Intact classes were randomly drawn and used for the study. The intact classes were randomly assigned experimental and control groups, the researcher could not alter their original composition, that is, the researcher did not randomly assign the class members (subjects of the study) to the classes. Hence, the design is described as non-randomized or quasi experimental design. The study was conducted in Enugu State located in the South-Eastern part of Nigeria. Under secondary education system, Enugu state is partitioned into six education zones namely; Agbani, Awgu, Enugu, Nsukka, Obolo-Afor and Udi. The population for the study consisted of 41,728 senior secondary school two students in Enugu state as at the time of the study. Out of this population 12,103 were in public secondary schools while 29,625 students were in private schools.

A sample of 664 Senior Secondary Two (SS2) students was used for the study. The sample consisted of 279 public schools' students and 385 private schools' students. Also the sample was composed of 335 students in the experimental group and 329 students in the control group. The sample was drawn from sixteen intact classes in the four public and four private secondary schools randomly drawn using simple random sampling techniques. Two instruments namely; Algebra Procedural Understanding Test (APUT) and Algebra Conceptual Understanding Test (ACUT) were used for data collection in the study. APUT and ACUT were constructed by the researcher and validated by three research experts. APUT was made up of 20 multiple choice questions with four options each. These 20 items were drawn using a table of specification. The items covered basic techniques measuring students' procedural understanding of algebraic expressions. Similarly, ACUT was made up of 22 multiple choice questions with four options each. These 22 items were drawn using a table of specification. The items covered basic techniques measuring students' conceptual understanding of algebraic expressions. Reliability coefficients obtained for APUT and ACUT were .86 and .91 respectively. Kudar Richardson formula 20 (KR-20) was used for reliability analyses.

Experimental Procedures

At first, the regular mathematics teachers of the sampled schools who served as research assistants administered APUT and ACUT to the students in both the experimental and control groups. The scripts were scored and recorded as pretest scores. Thereafter, the experimental groups in each school were taught the selected algebraic topics using CAI while their counterparts in control groups in each school were taught the same topics without CAI. The teaching period lasted for four weeks after which APUT and ACUT were readministered to the students in both the experimental and control groups. The scripts were scored and recorded as posttest scores. Mean and standard deviation were used to answer the research questions while hypotheses were tested at .05 level of significance using Analysis of Covariance (ANCOVA).

Results

Research Question 1

What are the mean Algebra procedural understanding scores of students in the experimental and control groups in both pretest and posttest?

Table 1: Mean Algebra procedural understanding scores of students in the experimental and control groups in pretest and posttest.

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental	335	20.50	2.11	78.47	0.11
Control	329	21.01	2.13	41.13	2.08

From table 1 above, the pretest mean score of experimental group was 20.50 while that of control group was 21.01. These suggest that both groups were almost of equal ability at the beginning of the experiment. In the posttest, experimental group had a mean of 78.47 while the control group had a mean of 41.13. Apparently, the two groups achieved higher in the posttest than the pretest indicating that learning took place. However, the posttest mean score of the experimental was higher than that of the control group. Moreso, a lower standard deviation value of 0.11 in the posttest for experimental group indicated that there were fewer extreme scores in the experimental group than the control.

Research Question 2

What are the mean Algebra conceptual understanding scores of students in the experimental and control groups in both pretest and posttest?

Table 2: Mean Algebra conceptual understanding scores of students in the experimental and control groups in pretest and posttest

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Experimental	335	20.81	3.12	81.75	0.13
Control	329	20.39	3.09	44.11	3.01

From table 2, the pretest mean score of experimental group was 20.81 while that of control group was 20.39. These suggest that both groups were almost of equal ability at the beginning of the experiment. In the posttest, experimental group had a mean of 81.75 while the control group had a mean of 44.11. Apparently, the two groups achieved higher in the posttest than the pretest indicating that learning took place. However, the posttest mean score of the experimental was far higher than that of the control group. Moreso, a lower standard deviation value of 0.13 in the posttest for experimental group indicated that there were fewer extreme scores in the experimental group than the control.

Research Question 3

What are the mean Algebra procedural understanding scores of public and private schools' students in the experimental and control groups in both pretest and posttest?

Table 3: Mean Algebra procedural understanding scores of public and private schools' students in pretest and posttest.

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Public (Experimental)	165	20.00	2.05	78.44	0.12
Private (Experimental	170	21.00	2.06	78.50	0.10
Public (Control)	114	21.02	2.07	40.09	2.10
Private (Control)	215	21.00	2.13	41.04	2.06

From table 3, above the pretest mean score of the public (Experimental) was 20.00 while that of private (Experimental) was 21.00. Also, the pretest mean score of the public (control) was 21.02 while that of private (Control) was 21.00. This result suggests that both experimental groups (public and private) achieved equally and both control groups (public and private achieved equally. The posttest mean score of the public (Experimental) was 78.44 while that of private (Experimental) was 78.50. Similarly, the posttest mean score of the public (control) was 40.09 while that of private (Control) was 41.04. This result suggests that both experimental groups (public and private) achieved equally and both control groups (public and private achieved equally.

Research Question 4

What are the mean Algebra conceptual understanding scores of public and private schools' students in the experimental and control groups in both pretest and posttest?

Table 4: Mean Algebra conceptual understanding scores of public and private schools' students in pretest and posttest.

Group	n	Pretest		Posttest	
		Mean	SD	Mean	SD
Public (Experimental)	165	21.02	3.14	82.00	0.14
Private (Experimental	170	20.60	3.10	81.5	0.12
Public (Control)	114	20.40	3.10	44.12	3.00
Private (Control)	215	20.38	3.08	44.10	3.02

From table 4, above the pretest mean score of the public (Experimental) was 21.02 while that of private (Experimental) was 20.60. Likewise, the pretest mean score of the public (control) was 20.40 while that of private (Control) was 20.38. This result suggests that both experimental groups (public and private) achieved equally and both control groups (public and private achieved equally. The posttest mean score of the public (Experimental) was 82.00 while that of private (Experimental) was 81.5. Also, the posttest mean score of the public (control) was 44.12 while that of private (Control) was 44.10. This result suggests that both experimental groups (public and private) achieved equally and both control groups (public and private achieved equally.

Hypothesis 1

There is no significant difference between the mean Algebra procedural understanding scores of the students in experimental and control groups.

Hypothesis 3

There is no significant difference between the mean Algebra procedural understanding scores of public and private schools' students in the experimental and control groups.

Hypothesis 5

There is no significant interaction between method and school type on students' mean Algebra procedural understanding scores.

Table 5: ANCOVA analyses of the students' Algebra procedural understanding scores.

Source	Sum of Squares	DF	Mean Square	F	Sig.	Decision
Teaching Method	921.400	1	921.400	2.469	0.000	S
School Type	89.212	1	89.212	0.239	0.340	NS
Teaching Method*School Type	56.371	1	56.371	0.151	0.251	NS
Error	246600.000	661	373.071			
Total	247666.983	664				

From table 5, teaching method gave an f value of 2.469 and this is significant at .000. Since .000 is less than 2.469 this mean that at .05 level of significance, the f value of 2.469 is significant. Therefore, hypothesis 1 was rejected as stated. This indicates that there was a significant difference between the mean Algebra procedural understanding scores of the students in experimental and control groups in favor of the experimental group. Similarly, the sum of squares arising from methods when compared with the sum of squares arising from error indicated that the observed difference in the achievement of the experimental and control groups was due to the treatment administered in the experiment.

School type gave an f value of 0.239 and this is significant at 0.340. Since 0.340 is greater than 0.239, this means that at .05 level of significance, the f value of 0.239 is not significant. Therefore, hypothesis 3 was not rejected as stated, indicating that there was no significant difference between the mean Algebra procedural understanding scores of public and private schools' students in the experimental and control groups. Additionally, the sum of squares arising from school type was highly insignificant when compared with the sum of squares arising from error. This implies that any observed difference in the achievement of public and private secondary schools' students in the experiment may have resulted from extraneous variable(s) rather than the treatment applied in the experiment.

The interaction effect (teaching method *school type) gave an f value of 0.151 which is significant at 0.251. Since 0.251 is greater than 0.151, this means that at .05 level of significance, the f value of 0.151 is not significant. Hence, hypothesis 5 was not rejected as stated because there was no significant interaction between method and school type with regards to the students' mean Algebra procedural understanding scores. Moreso, the sum of squares arising from method*school type was very insignificant in comparison with the sum of squares arising from error. This indicates that any observed differences may be due to extraneous variable(s).

Hypothesis 2

There is no significant difference between the mean Algebra conceptual understanding scores of the students in experimental and control groups.

Hypothesis 4

There is no significant difference between the mean Algebra conceptual understanding scores of public and private schools' students in the experimental and control groups.

Hypothesis 6

There is no significant interaction between method and school type on students' mean Algebra conceptual understanding scores.

Table 6: ANCOVA analyses of the students' Algebra conceptual understanding scores

Source	Sum of Squares	DF	Mean Square	F	Sig.	Decision
Teaching Method	789.450	1	789.450	2.479	0.001	S
School type	20.996	1	20.996	0.066	0.101	NS
Teaching Method*School type	5.633	1	5.633	0.018	0.121	NS
Error	210481.320	661	318.429			
Total	211297.399	664				

From table 6, teaching method gave an f value of 2.479 and this is significant at 0.001. Since 0.001 is less than 2.479 this mean that at .05 level of significance, the f value of 2.479 is significant. Therefore, hypothesis 2 was rejected as stated. This indicates that there was a significant difference between the mean Algebra conceptual understanding scores of the students in experimental and control groups. Similarly, the sum of squares arising from methods when compared with the sum of squares arising from error indicated that the observed difference in the conceptual understanding scores of the experimental and control groups was due to the treatment administered in the experiment.

School type gave an f value of 0.066 and this is significant at 0.101. Since 0.101 is greater than 0.066, this means that at .05 level of significance, the f value of 0.066 is not significant. Therefore, hypothesis 4 was not rejected as stated, indicating that there was no significant difference between the mean Algebra conceptual understanding scores of public and private schools' students in the experimental and control groups. Moreso, the sum of squares arising from school type was highly insignificant when compared with the sum of squares arising from error.

The interaction effect (teaching method *school type) gave an f value of 0.018 which is significant at 0.121. Since 0.121 is greater than 0.018, this means that at .05 level of significance, the f value of 0.018 is not significant. Hypothesis 6, therefore, was not rejected as stated because there was no significant interaction between method and school type on students' mean Algebra conceptual understanding scores. Moreso, the sum of squares arising from teaching method*school type was not significant in comparison with the sum of squares arising from error. Hence, any observed difference may be due to extraneous variable(s).

Summary of Findings

Findings made in the study can be summarized thus:

1. Secondary school students taught algebra with CAI gained more procedural understanding of algebraic expressions than their counterparts who were taught same topics without CAI.
2. Secondary school students taught algebra with CAI gained more conceptual understanding of algebraic expressions than their counterparts who were taught same topics without CAI.
3. School type (public/private) did not significantly influence secondary school students' procedural and conceptual understanding of algebraic expressions when taught with CAI.

Discussion of Findings

The findings of this study imply that teaching algebraic expressions is not just transmitting an immutable body of knowledge that students have to accept as a perennial fact without any reasoning. Learning algebra is an empirical activity, hence, learners are in position of constructing their own knowledge when taught with appropriate teaching method such as Computer Aided Instruction (CAI) The 'why' something works and not only 'how' should be emphasized.

Mathematics educators should bear in mind that it is often possible for learner's to learn the 'how' (that is procedures) mechanically without understanding 'why' it works (that is conceptual knowledge). Procedures learnt this way are often forgotten easily. Conceptual and procedural understanding actually help each other. Conceptual knowledge is important for the development of procedural fluency. While fluent procedural knowledge, supports the development of further conceptual understanding. The findings of this study show that Computer Aided Instruction can facilitate both conceptual and procedural understanding when properly utilized.

The findings of this study and the conflicting results of reviewed empirical studies imply that well designed CAI have the potentials to promote students' procedural and conceptual understanding of algebraic expressions. Hence, CAI software programmers and designers should bear in mind that the arousal features of CAIs need not overshadow the intended lessons. The play and amusement features of CAIs should elicit both emotional and cognitive interest of learners, seductive details should be eliminated. CAI modes should be designed as simple as possible. Hence, with minimum computer literacy or proficiency, a algebra teacher can use it to teach profitably. Secondary school proprietors in Nigeria include; the governments, individuals, churches, cooperate bodies and other non-governmental organizations. To these stakeholders the findings of this study imply that students taught algebra with CAI can achieve greater procedural and conceptual understanding of algebraic expressions regardless of their school type (public or private). To survive in this competitive generation, all school proprietors have to adopt computerization both in administration and the teaching/learning process. The era of buying computers and keeping them without putting them to use should be over. Adequate provisions (both financial and human) must therefore be made to ensure that students are taught with CAI.

The findings of this study have serious implications to the student. This is because the CAI, as a constructivist process, is a student-centered instructional method. Generally, in student-centered instructional methods, the students are in charge. The teacher offers minimal guides and allows the students to construct their own understanding by seeing relationships between incoming information and their previous knowledge. Students thus, determine their own knowledge based on their own way of processing information and according to his or her own beliefs and attitudes towards learning. From the foregoing, students taught algebra with CAI are expected to develop skills for in-depth analysis of any given algebraic problem. These skills will enable them think reflectively, creatively and productively. Since CAI mode is student-centered, it implies that if the process fails, students should bear commensurate blames.

Recommendations

Consequent upon the findings of the study, the following recommendations were deemed necessary:

1. Use of CAI for teaching secondary school algebra should be adopted by all public and private secondary schools in Enugu State.
2. Nigerian teacher education curriculum should emphasize the use of CAI in microteaching and teaching practice exercises to avail teachers more practical knowledge during their training.
3. Periodic practical oriented workshops and seminars should be organized for mathematics teachers on use of CAI for teaching mathematics generally and algebra in particular.

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