academicJournals

Vol. 8(15), pp. 1294-1303, 10 August, 2013
DOI: 10.5897/ERR12.172
ISSN 1990-3839 ©2013 Academic Journals
http://www.academicjournals.org/ERR

Educational Research and Reviews

Full Length Research Paper

Symbolic notations and students' achievements in algebra

Ebiendele E. Peter[1]* and Adetunji A. Olaoye[2]

[1]Department of Mathematics and Computer Science, Oduduwa University, Ife-Ibadan express way, Ile-Ife, Nigeria.
[2]Department of Science and Technology Education, Lagos State University, Ojo, Lagos, Nigeria.

Accepted 19 June, 2013

This study focuses on symbolic notations and its impact on students' achievement in Algebra. The main reason for this study rests on the observation from personal and professional experiences on students' increasing hatred for Algebra. One hundred and fifty (150) Senior Secondary School Students (SSS) from Ojo Local Education District, Ojo, Lagos, Nigeria formed the sample population for the study. Three research instruments were used for the study, questionnaires were constructed for both students' and teacher's to measure students' perceptions about symbolic notations like symbols, letters and signs in Algebra and how it affect their learning of Algebra, while the teacher's instruments measure the mode/strategies of teaching notation symbols in Algebra at the classroom levels. t-test and Chi-square (χ^2) at 0.05 level of significance were used to test the stated hypotheses. Results from the hypotheses among others shows that students' do not have interest in Algebra and the usefulness of Algebraic notations are not known to them because they were not introduced to Algebraic topics with notations symbols early enough in schools. Also, due to the inadequate modes/strategies in handling notations symbols by the teacher's at the classrooms also resulted in significant differences between the performance of students' in the achievement test with symbolic notations and without symbolic notations. It was recommended among others that the schools should have mathematics laboratories where different mathematics teaching materials could easily be at the reach of the teacher's.

Key words: Symbolic notations, Chi-square (χ^2), t-test, significance level, senior secondary school students, perceptions.

INTRODUCTION

The word "Algebra" comes from Arabic word "Al-jabar", its origins can be traced to an ancient Babylonians, who developed an advanced arithmetical system with which they were able to do calculations in an algebraic fashion with the use of this system. They were able to apply formulas and calculate solutions for unknown values for a class of problems typically solved today by using linear equations, quadratic equations and indeterminate linear equations. By contrast, most Egyptians of this era, and most Indian, Greek and Chinese mathematicians in the first millennium BC, usually solved equations by RHIND mathematics papyrus, Suiba Sutras, Euclid is elements, and the nine chapters of mathematical Art.

The Greek mathematicians Hero of Alexandria and Diophantus continued the traditions of Egypt and Babylon but Diophantus book Arithmetical is on much higher level. Later, Arab and Muslim mathematicians developed algebraic methods to a much higher degree of

*Corresponding author. E-mail: peter.ebiendele@yahoo.com. Tel: +234 803 3311292.

sophistication. Al-khowaratmi was the first to solve equations using general methods. He solved the linear indeterminate equations, quadratic equations second order indeterminate equations and equations with multiple variable.

Mathematics is known as one of the gate keepers for success in all fields of life. It is a common saying that mathematics is the mother of all subjects. That is why it is considered to be more than a subject and is conceived as a key for solving the problem. The first question which arises in our mind as teachers is that why we should teach mathematics to our students. One of the main objectives of teaching and learning mathematics is to prepare students for practical life. Students can develop their knowledge, skills, logical and analytical thinking while learning mathematics and all these can lead them for enhancing their curiosity and to develop their ability to solve problems in almost all fields of life. The problem solving nature of mathematics can be found in sub-disciplines of mathematics such as in geometry, calculus, arithmetic and algebra. Algebra is an important area of mathematics. Algebra is a generalized form of arithmetic and for the purpose of generalization of arithmetic; symbolic notations like letters and signs are used. No doubt, the use of these Algebraic notations makes it an abstract subject. Hence algebra is considered to be difficult area of mathematics.

Purpose of the study

Learners of Algebra should have a conceptual understanding about the use of the symbolic notations such as letters and signs and the context in which it is used. In other words they should know the situation in which the algebraic statements are made. Foster (2007) highlighted that if students are taught abstract ideas without meaning, this might not develop their understanding. He suggested that if teachers want students to know Algebra then they must be given a deeper understanding of the use of Algebraic signs and symbols.

The purpose of this study are;

(a) To determine students' perceptions about the symbols, letters, and signs in algebra and how do these affects their learning of algebra.
(b) To examine the extent to which symbolic notations affects students' achievement in algebra.

Statement of the problem

This study was designed to investigate students' perceptions about algebraic notations like signs, symbols and letters and how do these affects their learning of algebra. Also to examine the extent to which symbolic notations affects their achievement in algebra.

Research questions

(a) What are the academic performance of students' via achievement test of symbolic notations and signs?
(b) What are the students' perceptions about algebraic notations in learning algebra?

Research hypothesis

H_o: There will be no significant difference between algebraic notations via achievement test in algebra.
H_o: There will be no significant difference between students' perception about algebraic notations and their learning of algebra.

THEORETICAL FRAMEWORK

Researchers have found that students have preconceived ideas from personal experiences about what algebraic notations are supposed to represent, and often base their interpretations on these experiences, falsely assuming that all symbolic notations use are related. Kirshner and Awtry (2004) give evidence that students' working with algebraic expressions often respond spontaneously to familiarity with visual notational patterns when making decisions instead of relying on mathematical rules. Students' often do not reason about an overall goal or the concepts involved in a problem, but instead look for an implied procedure inherent in the symbols.

In the context of this study, the term symbolic notations refer specifically to Algebraic mathematical symbols. These symbols include letters, signs, symbols and equal signs. Bergeson et al. (2000) that the concept of variable is more sophisticated than teachers' expression and it frequently becomes barrier to student's understanding of Algebraic ideas. In this case the letter is seen as representing a range of unspecified values and a systematic relationship is seen to exist between two such sets of values. Symbolic notations are the components of the mathematics language that make it possible for a person to communicate, manipulate and reflect upon abstract mathematical concepts. However, the symbolic language is often a cause of great confusion for students'.

The misconceptions about the equal sign are common in the learning of Algebra (Carpenter et al., 2003). The concept of equality is an important idea for developing algebraic concepts among the learners of Algebra. NCTM (2000) showed the importance of the concept of equal sign (=) and suggested that more emphasis should be placed on students' interpretation of equal sign to ensure a foundation for learning Algebra. Much of elementary school arithmetic is answered oriented which interpret the equal sign as a signal to compute the left side and then to write result of this computation immediately after the equal sign might be able to correctly interpret algebraic equations such as 2x + 3 = x + 4.

Foster (2007) highlighted that if students' are taught abstract ideas without meaning, this might not develop their understanding. He suggested that if teacher's want students' to know algebra than must be given a deeper understanding of the use of symbols.

Wagner and Parker (2008) stated "though looking for key works can be a useful problem-solving heuristic, on probing about the use of equality sign, a student shared, the equal sign in algebra is used for showing both sides equal or it is also used for continuation of the problem solution by putting it against the expression''. Another student shared that "after equal sign the figure shows the answer, and we use equal sign for getting answer in the calculator". These quotes indicate that many students' failed to correctly interpret the equal sign (=) as a symbol to denote the relationship between two equal quantities in an equation. For them this sign is interpreted as a command to carry out the calculation. A major focus of recent research into the teaching and learning of algebra has been the transition from to algebra has been found to stem from problems relating to operational laws, the equal sign and operations on and the meaning of the variable.

My opinion is that, some students', visual serve as the dominant incentive for syntactic decisions instead of algebra rules. This idea was especially evident with Haspekian (2003). There are several conceptual obstacles in proceeding in algebra which are reasoned by understanding of letters and variables.

The researcher's argued that to improve college teacher's awareness of the network of understandings the students' have developed about mathematical sym-bols and the ways in which they learn to "see" the mathematic, that detailed look into the ways in which students' interpret algebraic symbols can hopefully be useful in identifying ways to strengthen students' under-standing of algebraic notations and improves their learning capabilities.

METHODOLOGY

Qualitative research design for exploring students' perceptions about the use of Algebraic notations like symbols, letters and signs in Algebra was used. Qualitative design is preferred in this study, since the natural setting is the direct source of the data (Fraenkel and Wallen, 2003). In the study, the researcher observed the research participants and collected data in their natural setting without controlling any aspect of the research situation. This study intends to find out students' perception, the effect of that perception on their learning and the reasons for their perceptions. The questions, based on the process of phenomenon, are best answered through qualitative parallign. This design made the author to have an in-depth understanding of the perceptions of students about the use of symbols in algebra and in exploring the factors which affect them in learning algebra. The study is particularistic because it focuses on specific phenomena such as program, event, process, persons, institutions or groups. Kyburz-Graber (2004) states a case study method on "how people specifically act in a concrete field of action, why they do so and how the situation observed may be explained" (p. 56).

Population

The targeted sample population consists of (150) students from Community High School, Ojo, Ojo High School and Lagos State Modern College, Ojo, South-West, Nigeria.

A sample of fifty Senior Secondary I (SSI) and Senior Secondary II (SSII) students were randomly selected from the sample population for the mathematics achievement test. These students' were between ages 14 to 18 years. The subjects were made-up of 84 boys and 66 girls. The students' were used because they have spent more years in the schools and were acquainted with the contents of the Senior Secondary School mathematics syllabus. Since the performance and learning difficulties of SSS III students' could not be dissociated from their background knowledge form SSS I and SS II. Hence they formed the basis for the sample population for this study. This is to make it possible for the researchers to compare the progressive poor learning difficulties associated with algebraic symbolic notations like signs, symbols and letters, the students' experiences in learning algebra.

Research instruments

The research instruments used for this study consists of two types of questionnaires for both SS I and SS II students' which contained eighteen and twenty-four items respectively: The items on the questionnaires favored both positive and negative attitude of students' perceptions about symbolic notations in learning algebra. Mathematics achievement test was administered as both students' on questions involving symbolic notations and questions without much symbolic notations. Also, teacher's questionnaires were designed to measure teacher's methodology/strategies of teaching the students' in learning algebra at the classroom level and the questionnaires were drawn on 5 points Likert scale.

i. Strongly Agree (SA)
ii. Agree (A)
iii. Disagree (D)
iv. Strongly Disagreed (SD).
v. Uncertain (U)

Validation of instruments

The mean scores for each of the items were interpreted thus: and item that falls between 3.75 to 5.0 indicates that there is keen interest, that is students' have positive aspiration on the item. 2.25 to 3.75 shows that the students' do not have much interest while 1.00 to 2.25 indicate no interest.

Reliability of instruments

The mathematics achievement for both groups were analysed using t-test statistics at 95% level of significance. t-test is use when comparing mean scores of two independent groups and also when the groups are randomly selected, provided the size is small for each group, say less than or equal 30.

Chi-square was used to test the stated hypothesis, because it can only be used when the data is nominal, consists of independent cases, sample randomly selected and the cell frequency should not less than five.

Table 1. Students' perceptions on symbolic notations.

Items No.	Nature of statement	Mean score	Remarks	Conclusion
1	Positive	2.36	Agree with	Positive
2	Negative	2.74	Uncertain	Uncertain
3	Negative	3.26	Uncertain	Uncertain
4	Negative	2.45	Uncertain	Uncertain
5	Positive	2.46	Agree	Positive
6	Positive	1.96	Agree	Positive
7	Negative	4.39	Disagree	Positive
8	Positive	2.25	Agree	Positive
9	Negative	3.72	Disagree	Positive
10	Positive	3.33	Uncertain	Uncertain
11	Negative	3.23	Uncertain	Uncertain
12	Positive	2.75	Disagree	Uncertain
13	Negative	3.72	Agree	Positive
14	Positive	2.16	Uncertain	Positive
15	Positive	2.68	Uncertain	Uncertain
16	Negative	4.08	Disagree	Positive
17	Positive	2.94	Disagree	Negative
18	Negative	3.65	Disagree	Positive

Procedures

We constructed 18 and 24 statement on the questionnaires to test students' perceptions about the use of symbolic notations and it impact on students' performance in Algebra. And these were administrated to the two arms of each SSS I and SSS II on the schools used as a case study. And fifty-eight algebra questions was constructed, 28 without much symbolic notations and 30 with symbolic notation to test students' achievement about symbolic notation as used in algebra and the two arms was given 45 min each to answer the questions.

RESULT

Table 1 gives the scores for each statement. The second column identifies the statement either as a positive or negative statement about symbolic notations in solving algebraic problems in mathematics.

The students' were uncertain about seven of the statements. It seems that the students' find it difficult to agree or disagree with the idea that symbolic notations make learning algebra a difficult topic in mathematics. They were also uncertain about the usefulness of algebraic symbols, signs and letters and its importance to other areas of mathematics as to whether it will help them to be accurate in their thinking.

This uncertain perception reveals that students' have not grasped the objective of teaching and learning algebra at the senior secondary schools syllabus. It is therefore the duty of the teacher's to constantly make students' realize that for one to survive the rigours involves in understanding some other basic concepts in mathematics, that one need to have a basic understanding of symbolic notations in proving theorems and other mathematical topics. From the negative perceptions of the students', one can deduce that students' perceive algebraic topics with symbolic notations usually not easy to learn. Hence, they do keep away from algebraic problems that involve symbolic notations. It seems as if the way the teacher's have presented algebraic problems with symbolic notation to students' had led them to such perceptions. Teachers should be able to teach algebra not as a conglomeration of un-connected factors but as a body of knowledge about the physical world; and also algebraic class should be made interesting and existing learning periods.

In Table 2, six items were used to find out the students' interest in algebra, where five of the items were positive and one negative. Each of the items bears a minimum marks of 1 and maximum 5, depending on the feeling of the students'.

Overall average mean $\frac{2308}{900} = 2.56$
Overall mean = 2.56 (inadequate interest)

Ever before the study, it was assumed that students' did not have positive attitude towards symbolic notation, which make it difficult for them to solve algebraic problems in mathematics. From the analysis as shown in the Table 2, this assumption has been proved right. The mean score for each of the items was interpreted accordingly. Any item that falls between 3.75 and 5.00 indicates that there is keen interest, that is students' have positive aspiration on the item. All items that fall between the mean scores 2.25 to 3.75 shows that the student's

Table 2. Students' perceptions about symbols, signs and letters in learning algebra.

Item	Nature of item	Mean	Response
19	Positive	2.96	A little bit
20	Positive	4.25	Everyone
21	Negative	2.71	Occasionally
22	Positive	1.60	Never
23	Positive	2.18	Rarely
24	Positive	1.68	Never

don't have much interest. The mean 1.00 to 2.25 indicates no interest. For all the six items, only item 20 received the student's overwhelming support that algebra is a subject that should be studies by everyone (mean score of 4.15). All other items, the students' shown negative attitude toward their responses.

Analysis of the teacher's modes/strategies in the teaching of algebra

Twenty instruments were constructed to enlist responses from teachers about their modes/strategies of teaching symbolic notations.

In item 1, a fairly appreciable number of teachers had relevant textbooks as could be adjudged from the teacher's assertion from the data, 20 teachers (66.67%) had relevant test books but most of the books are not to the reach of their students'. This might be caused by the non-availability of adequate textbooks in the market. There was consensus of the opinion by the teacher's on item 2 that chalkboard is one of the most important teaching aid to display symbolic notations in teaching algebraic topics in mathematics. 22 teachers (73.33%) always used chalkboard in their algebraic teaching. From the reactions of the teacher's in item 3, majority of the teacher's do not use teaching aids in teaching symbols, signs and letters in their classrooms considering the composition of teacher's in the senior secondary school classes, it was surprising that small percentage of the teacher's (46.67%) occasionally perform this activities while (33.3%) of the teachers abide with the use of teaching aid in teaching symbolic notations in algebra. It was also noted that some teacher's has never use any teaching aids in teaching algebraic notations in the classrooms. It is noteworthy that 90% of the teachers in item 10 copy examples from pupil's textbooks. The researcher opinion is that teachers should be remedied, they are expected to use their own initiatives to solve problems for instance, taking from the exercises since the examples are in the students' textbooks.

In item 6, many of the teachers upheld that they could get along well in teaching and solving algebraic problems without teaching symbolic notations as use in algebra topics in mathematics. This was not surprising because

Table 3. Analysis of students' response on symbolic notations.

Item	A	B	C	Total
12	6	6	7	19
13	9	12	13	34
14	0	0	1	1
15	34	21	32	87
16	13	12	24	49
17	0	0	2	2
21	8	7	7	22
22	43	29	41	113
Total	113	87	127	327

they have demonstrated this as they are used to copying examples from the textbooks and adequate relevant books are not always available. Good number of percentages revealed in other items analyzed as teacher's poor teaching aids attitude toward teaching notations symbols largely affect students' perceptions about symbols, signs and letters via achievement test in algebra.

Testing of hypothesis

Hypothesis was stated for the items 12 to 17 and 21 to 22 chosen from students' questionnaires and chi-square (χ^2) was used to analyse the data collected from the students' questionnaire. Table 3 shows the items in the questionnaire and the values of the observed values upon which the expected values were computed.

Hypothesis testing H_o: There will be no significance differences between students' perception about symbolic notations and their learning of algebra.

Table 4 shows the percentage facility index of Ho.

From Table 4, Chi-square (χ^2) can be computed thus: O = observed value; e = expected value

$$\sum \frac{(0-ei)^2}{Ei} \qquad 1$$

$$\frac{CT \times RT}{GT} \qquad 2$$

Where, CT = Column Total, RT = Row Total and GT = Ground Total

Degree of Freedom (df) (r-1) (c-1) = (8-1) = (7) (2) = 14

$$x_{real} = \sum \frac{(0-ei)^2}{ei} \qquad 3$$

χ^2 at 0.05 level of significant at 14 dlf = 23.68. The Chi-square calculated from Table 4 is 29.05. χ^2 at 0.05 level of significant at 14 dlf = 23.68. The Chi-square calculated from Table 4 is 29.05. Since χ^2cal > χ^2tab which state

Table 4. Presentation of Facility index (Ho).

Item number	12	13	14	15	16	17	21	22
Total number of each item (x)	19	34	1	87	49	2	22	113
%facility index	12.7	22.7	0.7	58	32.7	1.3	14.7	75.3

Table 5. Analysis based on the achievement test of senior secondary II (SSII) Art Students (Group I).

Nature of items algebraic problem	N	Mean (X)	Variance	T_{cal}	T_{tab}	Decision
Without symbolic notations	28	30.21	38.32	6.7	2.0	Reject
With symbolic notations	30	19.43	47.61			

Level of significance = 0.05

Table 6. Analysis based on the achievement test of senior secondary II (SSII) Science Students (Group II).

Nature of items algebraic problem	N	Mean (X)	Variance	T_{cal}	T_{tab}	Decision
Without symbolic notations	28	35.75	48.44	4.25	2.0	Reject
With symbolic notations	30	24.22	42.25			

Level of significance = 0.05.

that there will be no significant differences between students' perception about symbolic notations and their learning of algebra. This implies that symbolic notations have negative impact on students' perceptions via learning of algebra.

Analysis of students' achievement tests

Mathematics achievement test was administrated to senior secondary school one and two (SSS I and II), and the groups were divided into science and arts students'. 58 questions were constructed with both symbolic notations and without symbolic notations.

Hypothesis testing

H_o: That there will be no significant differences in the academic performance of students' in algebra via achievement test on symbols and signs.

Interpretation of results for senior secondary school II (SSII)

In Tables 5 and 6, the t_{cal} for the Arts students is 6.7 and the mean difference of 10.78 is in favor of their performance in solving algebraic problems presented without symbolic notations. The $t_{cal} > t_{tab}$ at 0.05 level of significance. Hence, we reject the null hypothesis and accept the alternative hypothesis. This implies that there was a significant difference in the performance of students' in Senior Secondary School II (Arts) in solving algebraic problems presented with symbolic notations. The students' performed better when algebraic problems without much symbolic notations in the achievement test.

The t_{cal} for the second group (Science Students') is 4.25 which is greater than t_{tab} (2.0) at 0.05 level of significance. We therefore reject the null hypothesis hence accepting the alternative. There was a significant difference in the students' performance of the achievement test presented with or without symbolic notations. Equally the mean difference of their performances is 13.53 in favor of their performance in algebraic problems without many notations symbols. In fact, the students' detest algebraic problems presented with symbolic notations because they have difficulties in translating them into reality.

Interpretation of results for senior secondary school I (SSI)

In Tables 7 and 8, the t_{cal} for Arts students is equal to 4.19 while that of science students is equal to 5.76 but the t_{tab} at 0.05 level of significance (2-tailed) was equal to 2.0, since for both classes (Arts and Sciences), the $t_{cal} > t_{tab}$, which indicates that there was a significant differences in the performance of SSS I students in solving algebraic problems presented with or without symbolic notations. Hence we do not accept the null hypothesis.

Implications

From the findings, it is evident that these teachers' do not

Table 7. Analysis based on achievement of Senior Secondary School I Art students on Algebra (Group I).

Nature of items algebraic problem	N	Mean (X)	Variance	T_{cal}	T_{tab}	Decision
Without symbolic notations	28	30.84	50.55	4.19	2.0	Reject
With symbolic notations	30	18.84	45.0			

Level of significance = 0.05.

Table 8. Analysis based on achievement of Senior Secondary School I Science students on algebra (Group II).

Nature of items algebraic	N	Mean(X)	Variance	T_{cal}	T_{tab}	Decision
Problem without symbolic notations	28	30.25	42.16	5.76	2.0	Reject
With symbolic notations	30	29.26	40.10			

Level of significance = 0.05.

posses adequate knowledge of the subject matter. In this case, students' are not given good foundation background essential for the understanding of the main concept of the topic. Consequently, the teacher's role in providing the right learning atmosphere and in guiding the students' through their learning experiences has been inadequate. This was manifested in the teachers' poor modes/ strategies. During the administration of the prepared questionnaires, it was observed that students' did not have much interest in solving questions presented with symbolic notations. Small percentage of the selected students' had reading materials on their own.

Enough teaching aids have not been made available by the schools and most teacher's have failed to improvise. This might be due to non-availability of these instruments in the market and those available are not always adequate for the teaching and learning of algebraic concepts. The bulk of the findings rest on the practical aspect and teacher's methodology and general poor perceptions about algebra symbolic notations by both the teacher's and the students'. The lack of an awareness of everyday practical application of algebraic symbolic notations was evidence in nearly all cases. It was discovered that students' could perform better in algebra problems without much symbolic notations instead of them to translate the symbolic notation like letters, signs in word problems into reality on their own.

DISCUSSION

For the purpose of this study, two different instruments were used and analyzed to ascertain the difficulties students' have with symbolic notations in algebraic problems.

The first instrument, seeks to find out the students' perceptions about Algebraic notations like symbols, signs and letters and their effects on the students' learning ability or, whether the students even like algebra at all as topic in mathematics.

The second instrument tagged "mathematics achievement test, one and two (MAT I and MAT II), where questions involved with symbolic notation and those without symbolic notations were constructed to ascertain the extent to which notations symbols affects students' achievement in algebra.

CONCLUSION AND RECOMMENDATIONS

Algebra is a language used to express mathematical relationship. Students' need to understand how quantities are related to one another and how algebra can be used to concisely express and analyze those relationships. The aim of the study was to explore students' perceptions about the use of symbolic notations and the effect of their perceptions on their learning of algebra. The study revealed that the students' have many misconceptions in the use of symbols in algebra, which affect their learning and solving algebraic problems.

It is vital that students' recognize that the symbols that are used to represent an unknown quantity or variable have different meanings in different contexts. Algebra is so significant as a part of mathematics that its foundations must begin to be built in the very early grades. But getting desired objectives, teachers' content knowledge and content provided by textbooks also play a significant role in promoting students' relational knowledge and conceptual understanding of algebra. For relational understanding the concepts of algebra and use of algebra as a tool to use it in real word situations it is important that the teachers should develop students' algebraic thinking and symbolic sense.

All students' can learn well if instruction is systematically approached. Home assignment and classwork given to students should not be set up as a task to be done but as a situation to be investigated to avoid boredom and indifference. Students work hard at things that interest them. Teachers should design work for students' as to avoid drudgery, boredom and frustration.

Teaching of algebra is like teaching a skill. So in teaching a skill, talking should be restricted to a few points. Talk and chalk should give way to learning and doing by the students' with the teacher's standing by to help where necessary, emphasis should be made on learning by doing. It is also recommended that the schools should have mathematics laboratory where different mathematics teaching materials could easily be at the teacher's reach. These can be designed and constructed from locally available materials like woods, plastics etc. Mistakes and error made by the students' should be corrected. Correction to these must be checked and marked accordingly. Students' should not be abused; rather they should be motivated for good behavior.

Concerning the climate of the classrooms, students' should be exposed to the four freedoms of the mathematics classroom. These are freedom to make mistakes, to ask questions, to think for one-self and to choose methods of solution. Emphasis should be made on the applicability of algebraic symbolic notations in other areas of mathematical computations. Ideas and statements which were introduced in lower level must not be only revised but also elaborated at a higher level of generality along with their applications to a new range of problems. This is to ensure continuity. The learning difficulties in solving algebraic problems in secondary schools can be reduced to the barest minimum if most or all of the above enumerated recommendations are taken into considerations.

REFERENCES

Bergeson T, Fitton R, Bylsma P, Neitze B (2000). Teaching and learning mathematics. Retrieved on January 12, 2008 from http://www.k12.wa.us/research/pubdocs/pdf/mathbook.pdfBless.

Carpenter TP, Franke LP, Levi L (2003). Thinking mathematically, Intergrating Algebra and Mathematics in elementary schools. J. Maths. Behav. 18(2):169-190.

Foster D (2007). Making meaning in Algebra examining students' understandings and misconception. Assessing Math. Proficiency 53:163-176.

Fraenkel JR, Wallen NE (2003). How to design and evaluate research in education, (5th ed.), McGraw Hill Publishing Company, Boston.

Haspekian M (2003). Between arithmetic and algebra: A space for the spreadsheet' contribution to and instrumental approach. Retrieved on May 22, 2007 from www.dm.unipi.it/didattica/CERME3/Proceedings/Groups/TG9/TG9HASPEKIAN.cerme3.pdf.

Kirshner D, Awtry T (2004). The visual salience of algebraic transformation. J. Res. Math. Educ. 35(4):224-257.

Kyburz-Graber R (2004). Does case study methodology look Rigor? The need for quality criteria for sound case study resources as illustrated by a recent case in secondary and higher education, Environ. Educ. Res. 10:53-65.

NCTM (2000). Principles and standards for school, retrieved on January 8, 2008, from http://www.nctm.org/standards

Wagner S, Parker S (2008). Advancing Algebra in Research Idea For the Classroom. High school mathematics, Retrieved on March 22, 2008 from NCTM. pp.154-174.

Students' questionnaires

Section A. On their perceptions about notation symbol.

S/N	No's of statement	SA	A	U	D	SD
1	I like solving Algebraic problems.					
2	Algebraic symbols makes algebra learning difficult					
3	Algebraic sign makes algebra difficult to understand.					
4	Algebraic symbol makes topics algebra very interesting.					
5	Algebraic letters are difficult to interpret hence makes learning of ALGEBRA difficult.					
6	Solving problems in Algebra makes mathematics interesting and understandable.					
7	Algebra is not a good topic in mathematics.					
8	Algebraic notations in problems solving makes me to develop a good reasoning ability.					
9	Algebraic letters makes Algebra a simple course in mathematics.					
10	Solving Algebraic problems amounted to waste of time.					
11	All students' must takes Algebra courses at school.					
12	Without Algebraic symbols topics will be meaningless.					
13	If there are no Algebraic letters students' will understand better Algebraic concepts.					
14	Without Algebraic signs, it will be impossible to solve algebraic problems.					
15	Algebraic topics are dull.					
16	Algebra will benefit only the brighter students'					
17	Algebraic problems-solving skills will help students' to solve real- life problems.					
18	Algebra should be removed as a branch of mathematics topics.					

Section B

INSTRUCTION: Read the questions and mark **X** in the box that seems to fit your feelings.

19. I like to study Algebraic topic's in mathematics.
    a. Not at all b. A little bit c. Very much.

20. Algebra is a subject that should be studied by all students'
    a. No one should study it b. Few people should study it. c. Everyone should it.

21. I think Algebraic notations are to be studied?
a. Always b. Occasionally c. Never.

22. Symbols, Letters and signs are exciting in solving Algebraic problems.
    a. Never b. Not always c. Always.

23. Do you think Algebra is a valuable and important topic in mathematics? Give reasons.
24. What aspect of Algebra do you like most?

Teacher's questionnaire

Section A

INSTRUCTION: Fill in the following questionnaire as honesty as possible. It has no bearing with professional records. It is strictly for research purpose.

INTRODUCTION:

1 Name of your school: ---

2 Class taught: --

3 Teaching experience: ---

4 How often do you teach Algebra in your mathematics periods.

a. Not always b. often c. occasionally d. rarely.

5. How many periods of mathematics per week do you teach?

a. Over 20 b. 16 - 20 c. 11 - 15 d. Less than 10.

5 How do you rate your students' performances in solving Algebraic problems.

a. High b. Average c. below average d. low

Section B

How often do you use the following items/instructional materials in solving Algebraic notations problems?
Tick where Appropriate.

S/N	Items/instructional materials	Never	Occasionally	Always
1	Relevant textbooks			
2	Chalkboard			
3	Providing mathematical instruments or other instructional materials to demonstrate symbols, signs and letters in Algebraic topics.			
4	Rise computer instructional programmes.			
5	Teaching of Algebraic vocabularies.			
6	Test items for evaluating students' understanding Algebraic notations.			
7	Solving mathematics problems with other teachers.			
8	Students' participation in class discussion.			
9	Assignment given to students'			
10	Copy signs, letters and symbols as an example from textbooks.			

Section C

This section is to access your general perceptions about notations symbols.
Tick where appropriate. SA = Strongly agree, A = Agree, U = Uncertain, D = Disagree, SD = Strongly disagree.

Items	Questionnaire statements	SA	A	U	D	SD
11	Algebraic symbols are not different from other mathematics symbols.					
12	It is difficult to interprete Algebraic notations symbols.					
13	Algebraic topics required manipulating and deductive reasoning before solving.					
14	Letters and signs are straight forward when solving Algebra problems.					
15	Algebraic topics improve students' comprehension ability when solving other mathematics problems.					
16	The students need to be assisted when solving problems involving notations symbols.					
17	Notations symbols are like magic.					
18	Notations symbols are essay understood when taught with instructional aids.					
19	These notational symbols are useful tools for reinforcing better understanding of other mathematics topics.					
20	Students' perceptions about Algebraic problems are not always the same.					