

Effect of Rusbult's Problem Solving Strategy on Secondary School Students' Achievement in Trigonometry Classroom

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The study investigated the effect of Rusbult's Problem Solving Strategy (RUPSS) on secondary school students' achievement in trigonometry in Fako Division in Cameroon. A sample of 366 form four students consisting of 186 males and 180 females were drawn from three colleges in the division by a multi-stage sampling technique. The Trigonometry Achievement Test (TAT) was used for data collection. Five experts, three in mathematics education and two in measurement and evaluation validated the instrument. The findings showed that Students exposed to the RUPSS achieved higher than those exposed to CPSS; Males in the RUPSS obtained a higher POSTTAT mean score compared to their female counterparts. The study recommends the teaching/learning of trigonometry via problem-solving strategies; Problem-solving should be incorporated into the curriculum in all institutions including teacher-training colleges and faculties of education in all universities in Cameroon.

Key words: *Problem-solving, gender issues, achievement, mathematics and mathematical sciences*

When two people talk about mathematics problem solving, they may not be saying exactly the same thing. The rhetoric of problem solving has been so pervasive in mathematics education that creative speakers and writers can put a twist on whatever topic or activity they have in mind to call it problem solving. The National Council of Supervisors of Mathematics (NCSM, 1978 p.3) stated, "Learning to solve problems is the principal reason for studying mathematics". Stanic and Kilpatrick (1988) opined that mathematics is synonymous with problem solving (doing word problems, creating patterns, interpreting figures, developing geometric constructions, proving theorems and so on). Otherwise, persons not enthralled with mathematics may describe any mathematics activity as problem solving. James, Maria and Nelda (2005) said that what is a problem and what is mathematics problem solving is relative to the individual. They urged that teachers and teacher educators should become familiar with constructivist

views and evaluate these views for restructuring their approaches to teaching, learning and researches concerning problem solving.

In the same line of thought, Shoenfeld (1985, 2008) said that to be solving a problem, there must be a goal, a blocking of that goal for the individual, and acceptance of that goal by the individual. Shoenfeld stated that what is a problem for one student may not be a problem for another either because there is no blocking or no acceptance of the goal. Shoenfeld situated a problem as having been given the description but do not yet have anything that satisfies that description. Shoenfeld described a problem solver as a person perceiving and accepting a goal without an immediate means of reaching the goal. According to Chris (2005) problem solving, in any academic area, involves being presented with a situation that requires a resolution. Chris said that being a problem solver requires an ability to come up with a means to resolve the situation fully. Chris added that in mathematics, problem solving generally involves being presented with a written out problem in which the learner has to interpret the problem, devise a method to solve it, follow mathematical procedures to achieve the result and then analyze the result to see if it is an acceptable solution to the problem presented.

A problem has an initial state (the current situation, a goal) the desired outcome, and a path for reaching the goal. Problem solvers often have to set and reach subgoals as they move toward the final solution (Schunk, 1991). Problem solving is what happens when routine or automatic responses do not fit the current situation. Some psychologists suggest that most human learning involve problem solving (Anderson, 1993). In the same line of thought, Obodo (1997) said that problem solving technique comprises the identification and choosing of mathematical problems which grow out of the experiences of individual students, placing these problems before the students and guiding them in their solutions. Obodo (1997) believes that this definition follows the steps of scientific method as well as those of reflective thinking. The teacher guides the class in solving the mathematical problem as a group. This technique encourages students to arrange and classify facts or data as well as allow students to learn from their successes and failures, since it permits the students to participate in their learning.

McGraw-Hill (1997) said that problems represent gaps between where one is and where one wishes to be, or between what one knows and what one wishes to know. Problem-solving is thus the process of closing these gaps by finding missing information, re-evaluating what is already known or, in some cases, redefining the problem. McGraw-Hill further stated that a well-structured problem is a typical situation with a known beginning, a known end, and a well-defined set of intermediate states. Solving a well-structured problem consist of finding an infrequently used

path connecting the initial state of the problem with its end state. People solve well-structured problems not by exhaustively searching through the set of possibilities, but rather by heuristically identifying good starting places and productive lines of search.

The activity of problem solving often consists of general strategies for linking up one stage with another in the search of a solution. A less powerful, though more general, strategy of a simple sort is referred to by computer scientists as generate-and-test and by psychologists as trial- and-error behaviour. It consist of picking a possible answer, trying it out, and if it does not work, trying another. Means-ends analysis and trial-and-error behaviour can require large amounts of time to complete, if the problem is complex, or may not lead to a solution at all in a practical amount of time. They have been successful in mathematical games and relatively simple problem-solving tasks. The activity of problem solving involves the use of problem-specific and knowledge-intensive methods and techniques, which are often referred to as heuristics. These heuristics are acquired through experience and represent the basis for expertise in a specific domain of problem-solving tasks such as physics, mathematics or medicine (McGraw-Hill, 1997).

Literature shows that problem solving is very difficult for secondary school students and that it is one of the principal causes of failure in school science and mathematics especially in trigonometry because it is a complex intellectual task. Research reports generally indicate that students' difficulties are associated with the lack of procedural knowledge/strategies, skills of solving problem and the reasoning skills that go along with them. This is because most mathematics teachers still teach using the conventional method. The conventional approach to teaching mathematics problem-solving (or Conventional Problem Solving Strategies, CPSS) involves the representation of worked examples in textbooks. Most of the worked examples do not teach the effective processes of problem solving in mathematics and the mathematical sciences. The conventional approach does not therefore teach the basic procedural knowledge/strategies and skills of solving quantitative problems.

The importance and the joy of problem solving using appropriate strategies were rightly stated by Polya (1973, p.5) that:

Your problem may be modest; but if it challenges your curiosity and brings into play your inventive facilities, and if you solve it by your own means, you may experience the tension and enjoy the triumph of discovery. Such experiences at a susceptible age may create a taste for mental work and leave their imprint on (your) mind and character for a lifetime.

Problem solving therefore, has an extraordinary importance in the study of mathematics. A primary goal of mathematics teaching and learning is to develop the ability to solve a wide variety of complex mathematics problems. Rusbult (1989) developed a 4-Phase model for problem solving as follows:

1. **Orientation:** Translate the problem's words, pictures and free information into a clear idea of *NOW* (the situation that is defined by the problem-statement) and *GOAL* (what the problem is asking you to do),
2. **Planning:** Figure out how to get from where you are *NOW* to the *GOAL*,
3. **Action:** Start doing your plan, and continue until you have reached the goal,
4. **Check:** Ask yourself, "Have I answered the questions that were asked? Have I reached the *GOAL*?"

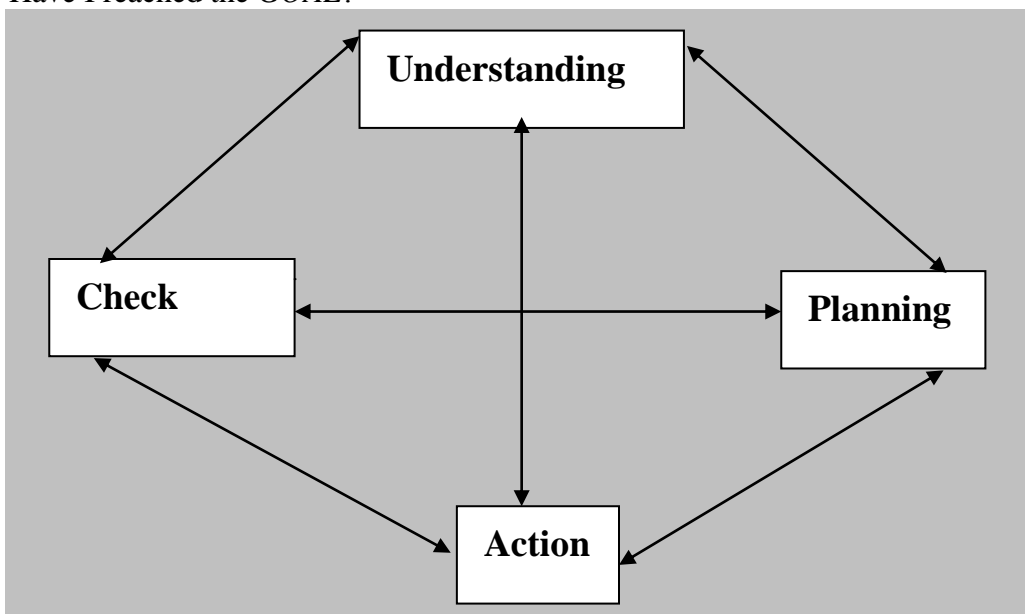


Figure 1: *Illustration of the practical stage of problem solving using Rusbult's (2005) framework.*

Most people enjoy the stimulating challenge of a good problem and the satisfaction of solving it. You feel this satisfaction more when you master the tools of problem solving (Rusbult, 2005). Rusbult believes that you get "oriented" by using all available information (words, pictures, and free information) to form a clear, complete mental picture of the problem situation. By reading the problem statement carefully, you get accurate comprehension, the meaning of words and sentence structure, so as to gather all the important facts. Most problems are written clearly, so use standard reading techniques to accurately interpret what is written. You may re-read a problem carefully for details, using the "successive refinements" methods.

Occasionally, a problem contains useless information (a decoy), so you need to learn to recognize what information to be used and what should be ignored. Study the diagram in the problem or make your own diagram because when the problem information (lengths, angles, forces, velocity and so on) is visually organized on paper, it is easier to understand it. This also helps to decrease your memory load, thus leaving your mind free to do creative thinking. The problem-writer may expect you to assume certain reasonable things about the problem situation (free information), or to use data that is not given in the problem but is available in textbooks, tables or in a special part of the exam.

Gagné's theory of learning proposed a method of learning mathematics known as "programmed learning" and emphasized guided learning. The programmed learning materials are designed to present information to the mathematics learner who is expected to respond to it by filling a blank or answering a question (problem-solving). After his response, an answer frame is exposed which informs him of the correct answer. If he is correct, he proceeds to the next frame. Otherwise, he repeats the exercise before he continues. This exercise is continued throughout the programmes (Gagné 1971). Gagné categorized learning into eight different types in a hierarchical order. The eighth category stated that problem solving is a type of learning that calls for the internal process of thinking. Two or more principles previously learned are somehow combined to produce "higher order" rule. In order to achieve problem solving, the pupils must recall learned principles, link together these principles so as to formulate "Higher order" rules and be allowed sufficient time for problem solving to occur.

Thinking is both physically and socially situated that problem tasks can be significantly shaped and changed by the tools made available and the social interactions that take place during problem solving. Situated cognition, a new model of learning, emphasizes apprenticeship, coaching, collaboration, multiple practice, and articulation of learning skills, stories, and technology (Brown, Collins, & Duguid, 1989). Self-regulation (or metacognition) plays a crucial role in all phases of learning and cross-domains. Schoenfeld (1987) stated that self-regulation has the potential to increase the meaningfulness of students' classroom learning, and the creation of a "mathematics culture" in the classroom best fosters metacognition. Schoenfeld (1983) showed that many problem-solving errors are due to metacognitive failure rather than lack of basic mathematics knowledge. Schoenfeld further said that all metacognitive strategies are illustrated in action, should be developed by students, and not declared by the teachers. It is assumed that students can be taught to become more self-regulated learners by acquiring effective strategies and by enhancing perceptions of self-efficacy. Poor learners can benefit from reciprocal teaching that through

process of modeling, guiding, and collaborative learning. The major responsibility of teachers is not to dispense knowledge, and no single teacher can teach students everything they need to know in their entire lifetime. Equipping students with self-regulated strategies will provide them with necessary techniques for becoming independent thinkers and lifelong learners.

Programmed learning and metacognition requires that trigonometry concepts should be linked up during teaching and learning such that the understanding of simpler concepts may generate understanding of the higher and more complex ones. The use of models, guidance and collaborative learning is also of great importance in the teaching and learning of trigonometry in secondary schools in Cameroon.

There is a body of research that shows gains in student achievement involving problem solving. Mettes, Pilot, Roosnick and Krammer-Pals (1980) observed that undergraduate students' skills in solving thermodynamics problems improved significantly if the four-stage model (Programme of Action and Method, PAM) they developed was coupled with mastery learning strategy. The National Assessment of Education Progress (NAEP) has shown gains in student achievement in the United States of America (Bay, 2000). Bello cited in Adigwe (2005) found that the Selvarantnam and Frazer model of 1982 significantly improved secondary school students' skills in solving stoichiometric problems in chemistry if it is coupled with practice, verbal feedback and remedial instructions or with practice and verbal feedback. The Third International Mathematics and Science Study (TIMSS) shows that students in the United States of America (U.S.A) still score well below the international average mark in eight grade mathematics (U.S. National Research Center (NRC), 1996). If the situation in the U.S.A is that bad with the high educational and technological advancements, what then is the situation of Cameroon?

Problem Statement

The methods and strategies employed to teach difficult topics like trigonometry in Cameroon need to be given serious attention. Literature has recommended the use of strategies to teach problem-solving involving word problems at all levels of education both nationally and internationally. There is therefore the need for unlimited research efforts geared towards improving the quality of mathematics teaching in Cameroon secondary schools. The problem of this study, posed as a question then is: what is the effect of Rusbult's problem solving strategy on secondary school students' achievement in trigonometry in Fako Division in Cameroon?

Purpose of the Study

The purpose of this study was to investigate the effect of Rusbult's Problem Solving Strategy (RUPSS) on secondary school students' achievement in trigonometry in Fako Division. The study specifically aimed at determining:

1. Mean achievement scores and standard deviations of secondary school students in trigonometry when taught via RUPSS and CPSS.
2. Mean achievement scores and standard deviations of male and female students in trigonometry when taught via RUPSS and CPSS.
3. Interaction effects between strategy and gender of the mean achievement scores as measured by Trigonometry Achievement Test (TAT) and CPSS.

Research Questions

The study was guided by the following research questions.

1. What are the mean achievement scores and standard deviations of form four students taught trigonometry via RUPSS and CPSS?
2. What are the mean achievement scores and standard deviations of form four male and female students taught trigonometry via RUPSS and CPSS?
3. What are the interaction effects between strategy and gender of the mean achievement scores as measured by Trigonometry Achievement Test (TAT).

Scope of the Study

The study was delimited to the effect of RUPSS on secondary school students' achievement in trigonometry in Fako Division in Cameroon. Fako division has the highest number of secondary schools in the South West Region. It was delimited to Baptist High School, Soppo; Government Bilingual High School, Muea and Regina Pacis Comprehensive College, Mutengene.

The study was also delimited to 2576 form four male and female students since the content of trigonometry considered is taught in this class. Trigonometry is unit 10 of the scheme of work for form four. It covers such content as:

- Angle of elevation and depression
- Bearings (2D-two dimensions only)
- Sine and cosine formulae
- Area of triangles and parallelograms

Design of the Study

The design of the study is the nonequivalent control group design. It is the quasi-experimental, non-randomized pre-test, post-test design. Shaughnessy, Zechmeister and Zechmeister (2003) declared that in the nonequivalent control group design:

- The treatment group and the comparison group are compared using pretest and posttest measures.
- If all the groups are similar in their pretest scores prior to treatment but differ in their posttest scores following treatment, researchers can more confidently make a claim about the effect of treatment.
- Threats to internal validity due to history, maturation, testing, instrumentation, and regression can be eliminated.

The design according to Ali (1996) was considered appropriate because it establishes a cause-effect relationship between the independent variables (strategy) and dependent variables (achievement). This design was also adopted because it was not possible to have a complete randomization of the subjects. Thus, intact classes were used as experimental and control groups since it is not advisable to disrupt existing classes in a school for three (3) weeks. Below is an illustration of the design.

Group	Pre-test	Treatment	Post-test
E	O ₁	RUPSS	O ₂
C	O ₁	CPSS	O ₂

Figure 2: An illustration of the non-randomized control group pretest-posttest quasi-experimental design.

Note:

- E = Experimental group
- C = Control group
- RUPSS = Use Rusbult's Problem Solving Strategy.
- CPSS = Conventional Problem Solving Strategy
- O₁ = Pre-Trigonometry Achievement Test (PRETAT)
- O₂ = Post-Trigonometry Achievement Test (POSTTAT).

Sample and Sampling Techniques

A multi-stage sampling technique was used. A total of 366 form four students consisting of 186 males and 180 females were drawn from the target population. The sample size of the students represents 24% of the total population. First, eight colleges were drawn from all the 52 colleges in the division by purposive sampling technique. Purposive sampling, according to Nworgu (1991), is a sampling technique in which specific elements are

selected because of their relative importance or because they satisfy some pre-conditioned criteria, and because of administrative ease of data collection. Then, three colleges were drawn from the eight colleges by simple random sampling technique. Intact classes in the three schools were used for the study such that all the students can benefit from the lessons. Simple random sampling was used to name two schools in relation to the experimental group (RUPSS) while the third school constituted the control group (CPSS).

Instruments for the Study

The Trigonometry Achievement Test (TAT) was used for data collection. In developing TAT, references were made to the achievement objectives for trigonometry as stated in the form four scheme of work. TAT also covered the concepts of trigonometry as outlined in the Cameroon General Certificate of Education Examination (CGCE) syllabus. TAT items were adapted from past CGCE examinations and recommended textbooks consisting of essay items. The internal consistency reliability coefficient of TAT scores was estimated at .77 using Cronbach Alpha (α) formula since the test consisted of essay type questions. The pre-TAT and post-TAT reliability coefficients of .88 and .72 respectively were obtained. The test-retest (stability) index of pre-TAT and post-TAT over a period of four weeks was computed to be .91 using Pearson's product moment correlation coefficient. The high reliability coefficient shows that TAT had the potential to measure what it was meant for.

Experimental Procedure

The researcher prepared a lesson on teaching trigonometry via Rusbult's Problem-Solving Strategy (RUPSS). In developing the lesson plans for problem solving, the concepts of trigonometry were listed and then, two or three problems on each concept were solved using the Rusbult's problem solving strategies. One or two other similar problems were given for evaluation and many others were given for practice purposes to conclude each lesson. The trigonometry concepts used are in accordance with the scheme of work drawn from the curriculum of the Ministry for Secondary Education (MINSEC). The lessons were presented to five experts for face validation. Suggestions were used to modify the lessons.

A regular mathematics teacher from one of the selected colleges and classes for the study was trained for 2 days working for two hours every day. The training drilled him on the content, methodology and the procedural design of the study. Another research assistant was selected but not given

any training since he taught the control group using the conventional strategy which he is used to.

The purpose of the study was never revealed to the subjects. Teaching started immediately after the pretest in each of the schools. One research assistant used the lessons prepared for the Rusbult's problem solving strategy to teach students in the experimental groups. The other research assistant taught trigonometry using the conventional problem solving strategy (CPSS) in a school, which constituted the control group. The researcher monitored the teaching at all the stages. Teaching lasted for three weeks, that is, four periods of forty minutes each for the three weeks ($40 \times 4 \times 3 = 480$ minutes = 8 hours). Post testing took place at the end of teaching in all the groups. The same TAT and TII used for pre-testing were administered as the posttest. Strict examination conditions were observed during post testing.

Administration of the Instruments

The researcher made arrangements with the class teachers and the research assistants on when the pre-testing was to take place. The pretest was given to the experimental group (RUPSS) and control (CPSS) on the same day. This was to avoid students discussing the test items and also, to avoid leakages. The teaching of trigonometric concepts via problem solving strategies started immediately after the pre-testing.

The post-test was conducted at the end of the third week of instruction. The same TAT used for pre-testing were administered to the students as the post-test. The same procedure and conditions used for conducting the pretest was adopted for the post-test.

Methods of Data Analyses

Mean scores and standard deviations were used for analyzing data to provide answers for the research questions. The hypotheses were tested at .05 level of significance using a two-way (2 x 2) Analysis of Covariance (ANCOVA). The pretest scores were used as covariates to the post-test scores.

Results and Discussion

(1) What are the mean achievement scores and standard deviations of form four students taught trigonometry via RUPSS in Fako Division in Cameroon?

Strategy	N	PRETAT		POSTTAT		Mean gain
		Mean	Std Dev.	Mean	Std Dev.	
RUPSS	108	14.29	10.53	39.29	19.66	25.00
CPSS	147	15.17	11.48	23.12	14.55	7.95

The 108 subjects that underwent the RUPSS treatment had a PRETAT mean of 14.29 with a standard deviation of 10.53 and a POSTTAT mean of 39.29 with a standard deviation of 19.66, registering a mean gain of 25.00. Also, the 147 subjects that underwent the CPSS (control) treatment had a PRETAT mean of 15.17 with a standard deviation of 11.48 and a POSTTAT mean of 23.12 with a standard deviation of 14.55, registering a mean gain of 7.95 after treatment. With all other factors kept at the barest minimum level, and by comparing the mean gains, the results show that RUPSS enhanced students' achievement in trigonometry in Fako Division in Cameroon.

Ho₁: There is no statistically significant difference in the mean achievement scores of the students taught trigonometry via RUPSS and those taught using the CPSS.

Table 2
A two-way (2x2) ANCOVA of POSTTAT Scores by Strategy with PRETAT as Covariate

Source of Variation	Sum of Squares	DF	Mean Square	F _{calculated}
Covariate	70758.418	1	70758.418	431.008
3.48	.05*			
Main Effects	20332.623	2	10166.311	61.926
3.48	.05*			
Explained	91091.041	3	30363.680	184.953
3.48	.05*			
Residual	59429.366	362	164.170	
Total	150520.407	365	412.385	

DF = Degree of Freedom P = Probability level * = Significant
RUPSS* (mean score = 39.2870) and CPSS (mean score = 23.1224)

* Denotes pairs of groups significantly different at the .05 probability level.

Considering the statistical analyses [$F_{(2,362)} = 61.926 > F_{.05} = 3.48$] for strategies, we rejected H_{01} stated that:

H_{a1} : There is a statistically significant difference in the mean achievement scores between the students taught trigonometry via RUPSS and those taught using the CPSS.

A study was conducted by Alio (1997) aimed at examining the effects of Polya’s Problem-Solving strategy (POPSOT) on students’ achievement and interest in mathematics. The major results indicated that there was a significant difference in the mean POSTMAT scores due to strategy used in the experimental and control groups. A significant difference was also found between male and female subjects in the mean POSTMAT scores in the experimental and control groups. Interaction effect between sex and strategy was found significant in the interest of students but not for achievement.

(2) What are the mean achievement scores and standard deviations of form four male and female students taught trigonometry via RUPSS in Fako Division in Cameroon?

Table 3
Means and Standard Deviations of PTRETAT and POSTTAT by Gender

Strategy	Gender	N	Pretat		Posttat		Mean Gain
			Mean	Std Dev.	Mean	Std Dev.	
RUPSS	Female	55	11.33	7.98	35.71	29.62	24.38
	Male	53	17.00	12.30	43.00	21.20	26.00
CPSS	Female	73	13.95	9.82	21.27	20.30	7.32
	Male	74	16.43	14.24	24.93	14.92	8.50

The 55 RUPSS female subjects recorded a PRETAT mean score of 11.33 with a standard deviation of 7.98 and a POSTTAT mean score of 35.71 with a standard deviation of 29.62, giving a mean gain score of 24.38. Whereas, the 53 RUPSS male subjects recorded a PRETAT mean score of 17.00 with a standard deviation of 12.30 and a POSTTAT mean score of 43.00 with a standard deviation of 21.20, giving a mean gain score of 26.00. The male subjects recorded a higher POSTTAT mean score and a slightly higher mean gain score of 1.62 more than the females. The difference between the mean gain scores in favour of the males which might have resulted by chance shows that both males and females benefited in the RUPSS. Hence RUPSS is also a good strategy that enhances achievement and bridges the gender gap in trigonometry in Fako Division in Cameroon.

The 73 CPSS (control) female subjects recorded a PRETAT mean score of 13.95 with a standard deviation of 9.82 and a POSTTAT mean

score of 21.27 with a standard deviation of 20.30, giving a mean gain score of 7.32. Whereas, the 74 CPSS male subjects recorded a PRETAT mean score of 16.43 with a standard deviation of 14.24 and a POSTTAT mean score of 24.93 with a standard deviation of 14.92, giving a mean gain score of 8.50. The male subjects recorded a higher POSTTAT mean score and a slightly higher mean gain score of 1.18. The difference between the mean gain scores in favour of the males which might have also resulted by chance shows that both males and females did not benefit enough from the CPSS. Hence CPSS is not a good strategy that could be used in the teaching and learning of trigonometry in Fako Division in Cameroon.

A Multiple Classification Analysis (MCA) based on gender can be done from the above data as follows: Male RUPSS > Female RUPSS > Male CPSS > Female CPSS

(3) What is the interaction effect between strategy and gender of the mean achievement scores as measured by TAT?

Ho₂: There is no statistically significant difference in the mean achievement scores of the male and female students taught trigonometry via RUPSS.

Ho₃: There is no statistically significant interaction effect between gender and strategy as measured by the mean achievement scores of TAT.

Table 4
A Two-Way (2x2) ANCOVA of POSTTAT by Gender and Strategies with PRETAT as Covariate

Source of Variation level	Sum of Squares	DF	Mean Square	F _{calculated}	F _{critical}	Sign.
Covariate	70758.418	1	70758.418	431.001	3.48	.00*
Main Effects	20347.853	3	6782.618	41.410	3.48	.00*
Gender	15.230	1	15.230	.093	3.48	.76
Strategies	20323.918	2	10161.959	62.042	3.48	.00*
2-way interaction (Strategy x Gender)	612.730	2	306.365	1.870	3.48	.15
Explained	91719.001	6	15286.500	93.329	3.48	.00
Residual	58801.406	359	163.792			
Total	150520.407	365	412.385			

Note: * = significant at .05 level of confidence.

The table shows that main effects [$F_{(3,362)} = 41.410 > F_{.05} = 3.48$] and strategies [$F_{(2,362)} = 62.042 > F_{.05} = 3.48$] are significant; a 2-way interaction of strategy and gender [$F_{(2,362)} = 1.870 < F_{.05} = 3.48$] is not significant; gender alone [$F_{(1,364)} = .093 < F_{.05} = 3.48$] is not also significant at .05 level of confidence.

Judging from the data available we fail to reject H_{02} and H_{03} and retain that: H_{02} : There is no statistically significant difference in the mean achievement scores of the male and female students taught trigonometry via RUPSS. H_{03} : There is no statistically significant interaction effect between gender and strategy as measured by the mean achievement scores of TAT.

Akor (2005) carried out a study to determine the effects of Polya's problem-solving strategy in the teaching of geometry on secondary school students' achievement and interest. The results of the study showed that Polya's problem-solving strategy enhances students' achievement in geometry more than the conventional method, [$F_{calculated} = 126.042$; $F_{critical} = 3.84$], the interest of students taught with Polya's problem-solving strategy was higher than those taught with the conventional method [$t_{calculated} = 1.59$, $t_{critical} = 1.96$, $df = 238$], there was no significant difference in the achievement and interest of males and females taught with Polya [$F_{calculated} = .161$, $F(1,237) = 3.84$], and the interaction between achievement and gender was not significant [$F_{calculated} = .388$, $F(1,237) = 3.84$].

Another study by Etukudo (2002) examined the effect of Computer Assisted Instruction (CAI) on gender and performance of junior secondary school students in problem solving involving quadratic equations. The analysis of the pretest and the posttest performance scores for the control group that was not exposed to CAI revealed significant differences in the performance of male and female students in favour of the females. The analysis of the posttest performance scores of the experimental group exposed to CAI revealed non-significant difference in the performance of male and female students. The researcher concluded that CAI assisted to remove the effect of gender by equalizing their performance.

Conclusion

The findings of this study served as the bases for concluding that RUPSS enhance students' achievement in trigonometry in Fako Division in Cameroon. Since RUPSS narrows the gender gap in mathematics performance, problem solving strategies are good instructional strategies for mathematics and the mathematical sciences and should be used to teach both male and female students in all institutions at all levels in Cameroon and beyond. Mathematics and the mathematical sciences should therefore be well taught by enthusiastic and qualified teachers via problem-solving strategies. These findings are in line with Gagné's theory of learning which proposes a method of learning mathematics known as "programmed learning" and emphasizes guided learning. The eighth category of this theory stated that problem solving is a type of learning that calls for the internal process of thinking.

Educational Implications

The results of this study have some implications for education in Cameroon. Problem-solving was proven to enhance achievement in trigonometry but students' gender was not a determinant of achievement in trigonometry in secondary schools in Fako Division in Cameroon. Females were as competent as the males when taught trigonometry via problem-solving strategies. Since the subjects for the study were drawn from public and private colleges, and because they are all aiming at the same goal (GCE O/L Mathematics code 570), it is of great importance that the same curriculum materials and instructional strategies be provided for all the schools irrespective of school-type, gender of students and denomination.

Recommendations

The following recommendations have been made based on the findings and conclusion of the study:

1. The findings of the study revealed that Rusbult's problem solving strategies enhance male and female secondary school students' achievement; arouse and sustain their interest and bridges the gender gap in trigonometry in Fako Division in Cameroon. The study thus recommends the teaching/learning of trigonometry via Rusbult's problem-solving strategies.
2. Teachers and students should learn to apply the psychological view of Rusbult's models in problem-solving because it consists of finding the right steps to apply at the right time or the creation/invention of new ways to convert one state of a task into another. In other words, trigonometry problem-solving involve the representation of the problem situation and the application of trigonometry principles in order to generate a solution. The study thus recommends the cyclic and the scientific approaches to problem-solving because they motivate the learners and develop the spirit of exploration and discovery.
3. Problem-solving should be incorporated into the curriculum in all institutions including teacher-training colleges and faculties of education in all universities in Cameroon. Authors and textbook writers should apply and provide proper illustration of Rusbult's problem-solving strategies in different areas of trigonometry. This may enable the students to be able to generate their own algorithm and generalize it into specific set of applications in trigonometry.
4. Seminars and in-service programs should be organized by all mathematics associations, examination boards, and delegations of education and the pedagogic offices for teachers in the field to be acquainted with the teaching of trigonometry via Rusbult's problem-solving strategies.

5. A model which attempts to bring together all the sequences and combines all the phases in mathematical problem-solving is as follows:

Understanding: Read and re-read the mathematics problem to get a clear idea of the situation and what is expected to be done. Explore the problem and identify the problem in definite terms.

Plan: Formulate tentative solution(s), a hypothesis (or hypotheses) for solving the problem. Collect relevant information for solving the problem and express the information using mathematical terms and/or symbols.

Solve: Try out the hypothesis (or hypotheses) by establishing a relationship between the known and the unknown variables in the problem-statement with the help of diagrams where applicable. Carry out the required operations and perform the necessary calculations in order to arrive at the answers.

Check: Test the acceptability or rejection of the solution by verifying how it fits the conditions of the problem. The problem is solved if the solution is supported, otherwise, revise the approach and/or try out an alternative hypothesis and repeat the process until a solution is obtained.

Problem posing: Posing related problems by altering some of the variables in the solved problem.

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