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Motivational Strategies in Teaching Mathemaics: Are the 'Tricks' Working for the Learner's Good?

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MOTIVATIONAL STRATEGIES IN TEACHING MATHEMATICS: ARE THE `TRICKS' WORKING FOR THE LEARNER'S GOOD?

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Abstract

In a class with 57 students in a room which measures 6m x 8m that has very limited resources, making sure that the students not only learn mathematics but like the subject as well is a Herculean task for any teacher in the Philippines, where large class size is a given condition. This paper which is based on the data gathered for the international research, Learner's Perspective Study (LPS), describes how the teacher in this particular class copes with these constraints through the use of motivational strategies and what the consequent effects of these are on the students' learning of and attitude towards mathematics. Specifically, the paper addresses the following questions:

1) What motivational strategies are employed by the teacher in teaching her mathematics lessons and what are the teacher's reasons for employing these strategies?

2) In what ways do these motivational strategies might have affected the students'

   (a) personal objective in learning the lesson;
   (b) understanding of concepts;
   (c) solving of problems;
   (d) enjoyment of mathematics or mathematics class;
   (e) view of a good mathematics lesson;
   (f) relating with their classmates when working on mathematical tasks;
   (g) view of their general achievement in mathematics; and
   (h) view of mathematics?

3) How do the teacher's perceptions of the effects of using these motivational strategies on student learning of and attitude towards mathematics compare with the researcher's analysis of the student data?

Background Information

The sample consisted of a grade 8 mathematics class with 34 girls and 23 boys of heterogeneous ability and belonging to low and average socio-economic status. The class ranked fifth among the 44 grade 8 classes in a public high school in a city in Metro Manila. Twenty-nine year-old Ms. Santos who had been teaching the subject in the school for 8 years handled the class. She was identified as the third most competent teacher by the mathematics supervisor of the city's public school system. The class was observed for 15 consecutive school days with the first 5 days serving as familiarization week. The last 10 days were the basis of the research study. Class time was 40 minutes per day. The lessons were on geometry, namely: undefined terms, congruent segments, betweeness, midpoint, coordinates of points, distances, angles, measuring angles, congruent angles, and angle addition property. The lessons were taught mainly in English but during the class, both the teacher and the students spoke a mix of English and the national language, Filipino.

As part of the LPS, this study used the complementary accounts methodology (Clarke, 2001). Daily, there was one video camera each that focused on the teacher, two focus seatmates, and the whole class. The focus students were randomly selected everyday. Placed in between the chairs of these students was a microphone that was attached to the mixer. There was on-site mixing of the students and teacher cameras. A researcher observed the class at the back of the room. At the end of the lesson, individual student interview stimulated by viewing the whole class video was conducted by the observer. The teacher was similarly interviewed, once at the end of each week.

Motivational strategies and their effects were not the focus of the LPS. Nonetheless, the answers to the research questions addressed in this paper were based on the relevant data gathered from classroom observations, teacher interview and students' interview.

Introduction

In a nationwide survey that assessed the training needs of Filipino high school mathematics teachers, 92% of the respondents reported that they sometimes or always used motivational activities in their lessons (Mathematics Education Group, 1996). They considered them as an important factor that contribute to an effective mathematics teaching. In another survey on what high school mathematics teachers wanted to change in the way they teach mathematics, a grade 10 teacher who had taught for 10 years and had undergone many in-service training programs expressed her belief that she needed "to improve the art of questioning and also motivation skills so that the students will not find mathematics boring" (Gallos, 1998). Indeed, in the Philippines teachers seem to recognize the truth that Deitte and Howe (2003) say: "Student motivation is an essential component of successful learning but it is also one of the most challenging for teachers." Their claim is consistent with what Sobel and Maletsky (1988) argue and that is "proper motivation for the teaching of mathematics is important because very few seem to have a natural love for the subject. Students need to have their interest stimulated through suitable teaching techniques and procedures."

Motivation refers to any reason why a person behaves in a particular way in a given situation (Middleton and Spanias, 1999). In the words of Slavin (1997), motivation is "what gets you going, keeps you going and determines where you're trying to go." In this paper, motivational strategy refers to anything that the teacher deliberately does to motivate students to learn mathematics.

Findings and Interpretations

Motivational Strategies

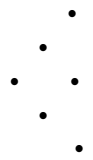
In 8 lessons, the series of activities consisted of introduction, lesson presentation, practice exercises, marking and discussion of answers to the exercises, quiz and giving of assignment. The introduction was either a discussion of the answers to the assignment or a review of the previous lesson through a quiz. In Lessons 1 and 3, a visualization problem and a guessing activity were used, respectively. Exposition was used to present the lessons where the teacher engaged the students in a quite rapid succession of question and answer with students responding to questions that required mostly short and factual answers.

Ms. Santos believed that a lesson was good if she was able to get the attention of the students, made them think, and many of them actively participated. With such a big class, she must have thought that she could accomplish these by her question-and-answer style of exposition. She could get and keep the students' attention because anyone of them might be asked to answer. By asking questions rather than by lecturing, she must have gotten the impression that she made them think. And with the questions requiring only short answers, she could make many students participate in the engagement.

The teacher specifically cited two motivational strategies. One was the use of interesting introductory activities such as the visualization problem and the guessing activity. According to her, these required the students to think. She also used them to develop the concepts that would be taken up in the lesson. This strategy must have been intended to make the students learn the lesson because it was interesting. The other strategy was called ganas. Based on class observations, there were two kinds of ganas. One kind (G1) was giving additional points, also referred to as plus factor, to the students who got perfect or almost perfect scores in a quiz or practice exercise. The other kind (G2) was giving additional points to a predetermined few number of students who first answered all the items in a practice exercise or quiz correctly. The second kind of ganas was also applied to the

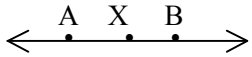
visualization problem in Lesson 1. Ganas must have been intended to make the students learn the lesson as they aimed to get additional points.

Practice exercises and quizzes were orally read by the teacher or written on manila paper and posted on the board. The nature of the items given in ganas differed. An example for each is given below. Table 1 below shows how ganas was used in the 10 lessons.

1. Non-routine problem solving: I have here 6 dots.  Move any 2 of the dots that will reverse the direction of the figure.

2. Identification: Tell what the following represents. a) Tip of a ballpen b) Clothesline

3. Draw: a) Line AB b) Three coplanar points X, Y, and Z.

4. Concept understanding: In the figure A, X and B are collinear points. 

Does $\overleftrightarrow{XB}$ pass through A?

5. Routine problem solving: Let the 2 angles ∠BAC and ∠BAD be coplanar and also let m∠BAC = 80 and m∠BAD = 60. If D is in the interior of ∠BAC, what is m∠CAD?

Table 1: Use of Ganas

Lesson No.	No. of Items in Quiz/ Exercise	Nature of Ganas	Time		Duration m=min, s=sec	Frequency of Ganas
			Start	End		
1	1	G2	2:14	4:02	1m 48s	4
	3	G1	17:57	20:12	2m 15s	
	3		21:49	24:42	2m 53s	
	5	G2	38:51	40:41	1m 50s	
2	None					0
3	3	G1	1:21	2:30	1m 9s	2
	9		18:15	28:40	10m 25s	
4	2	G1	20:35	24:56	4m 1s	1
5	Test					0
6	None					0
7	5	G2	32:37	33:49	1m 12s	1
				36:27	2m 38s	
8	3	G1	30:59	36:51	5m 52s	1
9	2	G2	12:23	13:34	1m 11s	1
				15:53	3m 19s	
10	Test					0

It can be gleaned from the table that there were lessons where ganas was used at least once. But there were also lessons when there was no test and yet ganas was not employed. The practice exercises and quizzes differed in the number of the items. The time spent for them varied from about 2 minutes to about 11 minutes. This means that the items must be answered rather fast. The start was when the teacher started to give instruction and the end was when she asked the students to stop answering. For Lessons 8 and 9, the first end time was when the targeted number of students who were supposed to have first answered all the items correctly had been met. With the frequency of the administration of ganas although the practice exercises and quizzes to which it is applied could be answered quickly, it is reasonable to expect that somehow it would influence the students in certain ways.

According to Ms. Santos, when she presented a lesson particularly when the topic is new, the students were very attentive and participative. Apparently, this was because of their question and answer engagement. But when it was already time for the practice exercises where they were to work and think on their own, they would not readily start working. It took them a long time to finish. And there were some who would not want to do them. She said that the students found the practice exercises boring. And she found the students slow.

The teacher must have thought of going around the room to assist and monitor every student during the practice exercises, a wish that she actually expressed during the interview. But because they were so many and the room was cramped, it was observed that she could only attend to very few students and they were mostly those who were sitting along the aisle. Since she could hardly get into the space between the rows of chairs it was seldom that she was able to assist the other students. It might be that with personal assistance particularly to the slow ones because the class was of heterogeneous ability, the teacher could have made students interested in doing the practice exercises. But with the large class size this was impossible.

One reason why the students were not interested in the practice exercises was perhaps because they did not have the opportunity to work on their own prior to this part of the lesson. Since the teacher used only exposition, there were no opportunities for them to explore and discuss mathematical ideas based on performing some activities. They were most of the time listening only to the teacher and responding to her questions. It might also be that since the answers would be given anyway, they simply waited for them.

Regardless of the reasons for the students' disinterest, the teacher decided to use ganas to motivate the students to do the practice exercises. But this decision must have been influenced by what she thought about what the students value. When asked about what her students' answers might be if they were asked why it is important for them to learn the lesson she said "in order to pass or get a high score if there is a quiz. Perhaps if the child is deep, it (the lesson) may be used in succeeding lessons. But I guess in general, to get a high score on a quiz or to pass Math 2 (grade 8 Mathematics)." Perhaps she thought that since the students value grades, then by giving them additional points if they work on the practice exercises quickly and correctly, this would make them want to work on them.

Qualifying for additional points required speed and accuracy. One reason why Ms. Santos required speed besides accuracy might have been to get the students started right away, keep them focused and get them finish soonest. But what she admitted as a possible reason was her experience of being a trainer of contestants to the Mathematics Teachers Association of the Philippines competitions for the past 8 months at the time of this research. In the trainings for and in the competitions themselves, the contestants were asked to solve problems with the time limit of 60, 30 or 10 seconds. Naturally, such time pressure was applied to contestants because speed and accuracy were the essence of competitions. But Ms. Santos required the same from all the students not all of whom were good in mathematics or liked it. That was why she must have found them slow. She recognized that such requirement created pressure on students but she told them to "get used to pressure because everything in life involves pressure." However, it was observed that she extended the time a little longer when the students complained that they were not yet finished working.

The accounts presented suggest that there is an interplay of teacher's experiences and beliefs of what the students value which influence the kind of motivational strategy used.

Effects of Motivational Strategy

1. Students' personal objectives in learning the lesson

Table 2 below summarizes the distribution of students of various achievement levels by their personal objectives in learning the lesson in relation to whether the lesson when they were interviewed had ganas or not.

Table 2: Personal Objectives of the Students in Learning the Lesson

Objectives	Lesson		Frequency
	With Ganas	Without Ganas	
(1) To answer ganas or get plus factor	G, A, B	A	4
(2) To answer all the teacher's questions, to get perfect in all activities, to have things get better	G, 2A	BA	4
(3) To get high score in the test, to get correct answers to difficult test items	0	2G, 1A	3
(4) To learn, to understand the lesson	2G	0	2
(5) To answer the interview questions	W	0	1
(6) None	2A, BA	3A	6

Achievement Level: B – Best A – Average W - Weak
G – Good BA – Below Average

Four (25%) of the focus students explicitly mentioned getting the ganas or plus factor as what they expected to happen in the lesson. All of them were at least of average achievement, with the best student in mathematics included. This means that the better students aimed for the plus factor. Except for one, all the lessons for which they were interviewed had ganas. This implies that a student wished for a plus factor even when the lesson did not offer one suggested the intensity of her desires to have ganas. The answers in (2) might have indirect reference to ganas while those in (1), (2) and (3) might indicate that the students considered grades as important. And this finding is consistent with the perception of the teacher cited earlier. The students in (4) were intrinsically motivated because despite the administration of ganas in their lessons, what they wanted was to learn. They were in contrast with the students in (1), (2) and (3) who were extrinsically motivated by grades.

The objective of Michaela who had the highest grade in Mathematics was to get the plus factor. Mathematics being her favorite subject, even without being assigned, she answered the items in "Extra for Experts" in the textbook. Because of her high grade, she was a member of the Mathematics Club. She also attended the Program for Excellence in Mathematics which was intended only for those who excelled in mathematics. Her objective may be understood in light of her account of her previous experience and belief.

> "… maybe because of my experience in the elementary when I was dumb in Math. I said, I'll reach the top. So what I can do, I will really do so that I'll be the highest in Math. Because if you're the highest in Math, as if you're really smart because almost all students do not like Math."

Michaela's view matched what Scwartz (in Gilroy, 2002) commented. "Society puts such an emphasis on mathematics as an indicator of intelligence that if students are not good at it, they feel a bigger sense of failure. They believe that they are not smart." Her view was also shared by a classmate, Kathy who thought that a very good student in mathematics was one who when the teacher asked a question only he could answer.

The prestige or recognition that was associated with being the best in Mathematics motivated Michaela to do well in it. And for her, ganas provided the opportunity for obtaining the desired recognition. Apparently, the motivational strategy was effective to the extent that it was consistent with the objective of a person.

2. Conceptual understanding

There were no data gathered from which it could be inferred that the motivational strategies identified by the teacher affected the student's conceptual understanding. Perhaps because ganas was used only during practice exercises and quizzes after the concepts had already been presented, then it is possible that ganas might not have an effect on the understanding of concepts that students had.

A student's conceptual understanding would be most affected by how the student encountered the concept. And in Ms. Santos' class, this was through the teaching strategy that she used. The students' encounter involved mainly listening attentively to the teacher's exposition. In fact, when they were asked how best they could learn a lesson like what they took up, they all said by listening.

What the data showed was that some of the students did not have a correct understanding of concepts which might have emerged during the lesson or elsewhere but were still not corrected there. For example, Kathy learned that a plane is a "flat surface" with many directions. She extended the sides of a rectangle beyond its vertices to show the directions. Ronaldo said that at least 4 points, the corner ones, determine a plane because the examples given about the plane were always squares. Roger claimed that if 3 points are non-collinear, then they do not determine a plane because the teacher said that the shape of a plane (a rectangle) has 4 sides but what he was able to form only had 3 sides. Apparently, these students grasped only the physical but not the mental representation of a plane as a never ending flat surface having an infinite number of points. They also did not interpret "3 non-collinear points determine a plane" as "Exactly one plane contains 3 non-collinear points."

While Ms. Santos might have thought that exposition led to a good lesson, it appears that it did not foster conceptual understanding.

3. Solving routine problems

After discussing a topic or procedure, the teacher gave practice exercises or routine problems to which the students were expected to apply what they had just learned. According to Michaela, a problem (routine) could be solved in more than one way. After a ganas item, she discussed these two solutions to it.

Problem: A, B and C are 3 points on a line such that C is between A and B. The coordinate of C is – 5. AB = 15 and BC = 7. What are the coordinates of A and B?

Solution 1: -5 + 7 = 2. So B = 2, AB = 15. So, 2 – 15 = -13.

Solution 2: -5 + 7 = 2. So B = 2. AB = 15. This is the full.
CB = 7. This is a part. So 15 – 7 = 8 = AC which is the remaining part. It is given that C = -5. A is to the left of C. So –5 – 8 = -13.

For the ganas, she claimed that she used the first solution and applied the rule "going to the right, you add; going to the left, you subtract" which the teacher said. "It's just quick thinking. Because what is easy for you, that's what you do." In the context of ganas, she seemed to say that applying the rules was important because they readily enabled one to give the answer.

4. Enjoyment of mathematics or mathematics class

Only one student directly linked her not enjoying the Mathematics class to ganas. She was generally happy in the class because the teacher made jokes but she did not enjoy it when she did not earn points in ganas. Another student associated her not enjoying mathematics to ganas. She said that sometimes she did it not enjoy mathematics because "if there are 1 to 5 items, if you get 5 you get a plus factor but if you get 4, you don't get the plus factor. So others are already getting 7 points while we haven't gotten anything." Both students expressed their frustration for not being able to get the reward offered by the motivational strategy.

The reasons given by other students for enjoying the mathematics class were the teacher taught well, they easily understood what she explained, she was kind and cracked jokes, they were happy, and she repeated explaining if they did not understand at once. It is interesting to note that the students attributed their enjoyment to the teacher. No one claimed that he enjoyed the class because he was challenged to think, was able to solve a difficult problem, or discovered something new. This is to be expected because the main learning style of the students was listening intently to the teacher. This matched the teacher's strategy of teaching which was exposition. Enjoyment is a motivational effect. This means that the teacher's personality trait and teaching skill of explaining clearly and patiently until the students already understood the lesson had a motivational effect.

Those who enjoyed mathematics claimed that mathematics would be useful for their future life, and it was their favorite. There were those who enjoyed it only when it was easy, when they already knew it or when they could understand it.

In general the students attributed their enjoyment to external factors. Table 3 below shows the enjoyment of the mathematics class in relation to the students achievement level.

Table 3. Students' Enjoyment of the Mathematics Class

Achievement Level	**Enjoyment**		
	Yes	**Sometimes**	**No**
Best	1		
Good	6		
Average	7	3	
Below Average		1	1
Weak		1	

It may be gleaned from the table that those who were at least average in achievement level generally enjoyed the mathematics class. Those who were of at most average achievement level did not enjoy the mathematics class just as much.

5. Good mathematics lesson

For 4 of the students, a mathematics lesson was good if they understood it; for 5, if they learned something new; for 3 if it was easy; for 3 if they knew it; and, for 1, if the teacher explained well. So there was no direct association made between the motivational strategies and the students' view of what constituted a good mathematics lesson.

This may imply that the strategies that lead to student understanding and acquisition of new knowledge and are related to what they know can have a motivating effect.

6. Relating with classmates on mathematical tasks

Six out of the 20 students asked their brighter classmates to teach them when they did not understand the lesson or when they missed a class. In fact, Myrna claimed that she enjoyed their mathematics class because they helped each other. When they would have a test and some of them were confused, they would ask Michaela to give them examples for clarification. Elena also asked Michaela for help and she in turn was asked by her seatmate to teach her. So in this sense, there was sharing in the class. A different atmosphere was created when there was ganas.

The additional points earned by each student was monitored by the teacher by giving them stickers with equivalent points. At the end of the grading period, the students returned them to the teacher. The additional points were to be added to the component of the grade where most of the class got lowest. To distribute the chance of getting extra points to as many students as possible, the teacher banned those who had already accumulated many points when the end of the grading period was still a long way to go, from participating in ganas. Nevertheless, these students were still expected to work on the items.

During ganas practice exercises or quizzes, students were concerned if others were already banned because they seemed to realize its implication on the possibility of their qualifying for a ganas. Below is an account of how two seatmates in Lesson 9 related to each other when the teacher announced ganas and she instructed the first 5 students who thought that they got the correct answer to stand up. One was conscious of what the other already had. She was on the alert to report the other's points to the teacher.

Michaela: Yes! I am no longer banned.
Ana: You're still banned! You're still banned! You're still banned!
Michaela: I'm no longer banned! I'm no longer banned!
Ana: Ma'am, isn't it that Michaela is already banned?
Michaela: Hm, Ma'am I'm no longer banned?
Ana: Still banned!
Michaela: This is too much! They hurt me.

Michaela got the correct answer but was not able to stand up. She remarked "I'm correct. It's a waste that I wasn't able to stand up." And Ana remarked in return "It's a pity that you don't have plus."

After the answers were discussed, Michaela told Ana that she would inform the teacher that she should also be banned. She accused her of claiming fewer points than she actually had.

Earlier in Lesson, 8 the teacher informed Michaela that she was banned temporarily. When she said that it was unfair, the teacher said that it was not so because she needed to give chance to others. The students who were listening said that they were pitiful and that Michaela should give them points.

So in ganas exercises particularly G2, the students regarded each other as competitors.

7. General achievement in mathematics

Five of the 20 students viewed their achievement in relation to that of others. Three of these five regarded speed and accuracy, the elements of ganas as the bases for the comparison. Rodan considered himself of average achievement because "some of my classmates are good. They are very fast in solving problems and are able to give the correct answers to all the questions. Sometimes, some of my answers are wrong and I'm slow in answering the questions." Lorenzo considered his achievement as below average because "I don't quickly memorize or sometimes I forget." Meanwhile Abenina claimed that she was of average achievement because "I find mathematics sometimes easy and sometimes difficult. The good ones are those who quickly understand." Regardless of their

perceived relative standing, all the students considered effort as responsible for their performance. Those who considered themselves good, cited themselves and were also cited by others as helping those who sought help in mathematics.

The above accounts show that the motivational strategy, ganas, affected how the students perceived their relative achievement in mathematics.

8. View of mathematics

Several students viewed mathematics as a collection of rules. Here is an account where Mariana referred to rules in mathematics. Mariana claimed that she did not use a "system" (referring to a rule) anymore to find the coordinate of N given that FN = 22, U is the midpoint of FN and F's coordinate is –8. She reasoned that "U and N are on the right while F is on the left so it is negative." The total when F and N are combined is 22. Since it is going to the right, she just made "-8 to plus 8" because if she has –8, she did know how to add something to it. So she thought, "what will I add to 8 to get 22?" She considered "10 + 8, then 12 + 8, then 14 + 8. So the coordinate of N is 14."

It is possible that the students realized that in ganas exercises where there was a time limit, using the rules became very crucial. In one ganas exercise with time limit of one minute, the teacher gave this "clue" while the students were answering the items "If it is to the right, add. If it is to the left subtract." With such instances, it is was possible that ganas reinforced the students' view that mathematics is a set of rules which they did not necessarily understand but could be very useful to them especially in ganas.

In exposition, the students were not given the chance to explore and based on the results of their explorations make generalizations which become the rules. So in the expositions, what might have been emphasized were the rules and not the reasons behind them. With ganas exercises, the students might think that by memorizing rules they could increase their chance of qualifying for ganas.

Comparison of the teacher's perceptions of the effects of motivational strategies on student learning of and attitude towards mathematics and the researcher's analysis of the student data

According to the teacher, ganas had different effects on the students. She cited that the accuracy and speed of some had been enhanced. Indeed, Roger and Myrna claimed that they were reciting more often now and were getting higher grades in the quizzes than in the previous grading period. They attributed these to aiming to do better and working harder. And such action might have been influenced by the atmosphere of competition that ganas fostered.

Ms. Santos also commented that others still could not cope. And Lorenzo could be an example of this. He liked Mathematics until Grade 6. But in high school, he did not understand it very well anymore. According to him, there seemed to be many procedures and things to memorize so he already found it difficult. He no longer enjoyed mathematics.

Thus, the teacher's perceptions about student learning of and attitude towards mathematics were consistent with the data.

Summary: Although the teacher explicitly stated using two motivational strategies, only ganas, the strategy that gave rewards for engaging in practice exercises or quiz in a desired way appeared to have affected specific student variables. The large class size, the teacher's belief about what the students consider important and her previous experiences influenced her decision to use ganas. Ganas had different effects on students. Some students had acquiring additional points as their objective in learning the lesson. They applied rules in solving routine problems to comply with the time limit. They did not enjoy their mathematics class or mathematics if they did not earn ganas points. They viewed their relative achievement in mathematics based on the requirement of ganas which were

speed and accuracy. They viewed mathematics as a set of rules that have to be memorized so that they were accessible during ganas. The strategy created an atmosphere of competition.

No association with students' conceptual understanding and view of a good mathematics lesson was found. Perhaps it was the teaching strategy used in presenting the lessons that had a direct bearing on these rather than ganas which was used only during the practice exercises and quizzes.

Conclusion and Recommendations

So do the motivational strategies, in this case only ganas, work for the learners' good? Bearing in mind the students who were extrinsically motivated, in the language of Clarke (2001), ganas provided mutual affordances to both these students and the teacher. They both achieved their objectives. But considering those who might be similarly motivated but whose achievement levels were not high, ganas could lead to a frustrating experience. With the interplay of a teacher-centered strategy of teaching, ganas promoted an impression among the students that mathematics consisted of rules or procedures which had to be remembered even when they did not fully understand them. Along this line, it may be good to learn that in relation to engagement in numeracy, the study of Francis (2003) revealed that implementing extrinsic rewards and creating a competitive classroom environment did not have lasting positive effects. But implementing a hands-on approach to learning which must be by student-centered teaching, positively affected engagement and motivation. Schiefele and Csikszentmihalyi (1995) also suggest that more active and student-involved activity be used to increase student interest in mathematics.

The strategy of the teacher in presenting lesson should thus be more student – centered. If the students are given the opportunity to do mathematical explorations and discuss mathematical ideas, then during times of practice exercises, they will not be bored for they will already be used to doing and thinking on their own before this. As the study of House (2003) shows, the teaching strategy used has motivational effects on students' learning. That is, it can itself be a motivational strategy. The inherent enjoyment that is derived from discovering mathematical ideas rather than getting them simply by listening to the teacher can sustain students interest even in quizzes or practice exercises.

With a more student –centered teaching strategy in place, it may be interesting to find out the effects of a modified ganas. Probably if the questions included in ganas can be improved so that they require higher order thinking, then it can be used to deepen conceptual understanding. This may remove the view of some that mathematics is a set of rules which needs to be memorized and without which it will be difficult if not impossible to get the correct answer to mathematics problems. Perhaps, accuracy may be a sufficient requirement of ganas. But if speed is to be included also, the time limit should be reasonably longer. This should communicate to the students that what is valued primarily is not how fast they can answer correctly short and easy questions but how well they can think of creative answers to nonroutine problems. If only accuracy is considered, then everyone gets a fair chance of being successful. No one needs to be banned because one's being successful would not deprive others of being successful too just because they are not as fast as the others (Slavin, 1997). Thus there will also be no frustration that would result from being banned.

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