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Posamentier, A. S. & Krulik, S. (2012) *The Art of Motivating Students for Mathematics Instruction*. New York: McGraw-Hill

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The Art of Motivating Students for mathematics

Instruction is one book in a series of practical guides mainly for helping the teacher of mathematics. Several of the books in the series, could be used in other disciplines with great success. Dr. Posamentier, Series Editor, states in the very beginning new teachers face many réalités when they enter their first classroom and this practical guide series hopefully will be valuable to them. Some of the realities they face include motivation. This guide was developed to help these teachers have a positive start to their career which in turn will most likely be the best path to help them become master teachers. One of the major purposes of the series is to address teacher retention. Many teacher leave during the first five years of teaching as they do not have the mentorship and guidance needed at this crucial time. Dr. Posamentier (p. ii) writes, “A positive

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start to a teaching career is the bet path to becoming a master teacher!”

Posamentier and Krulik do not give a formal definition or formula for motivation; however, they do propose the best teachers can and do motivate students. They try to begin each and every class in an way in which it creates interest and allows their own genuine enthusiasm to be apparent and remain so during the upcoming lesson. Motivation appears to be how to channel students’ interests to a specific topic to be learned. The proposed activities will bring the students together as a group unlike many beginning activities which have a tendency to actually divide the students into group by academic ability. The best teachers want all students to be involved and the class goal is for all to master the concept. These activities are not intended to let the higher ability students work the problems while other students just sit by. This can be an opportunity for the lower ability students to drift into another world of thought a long distance from the dreaded mathematic class. The motivational ideas if used on a regular basis will have many students even declaring that coming to mathematics class is fun and not the pain it was in previous years.

Each and every teacher should have as his/her goal to teach an effective lesson each and every day. With this in mind it is especially important that especially secondary-mathematics teachers have the tools to motivate or create an interest and desire to learn in their students. Many students arrive in the mathematics classroom not very excited or enthusiastic about the class. The teacher has a dual task at this point, first to get the students interested, motivated and excited about math and secondly to help the students master the content. Most of the students will be faced with state tests such as end of course exams and college entrance tests in a short time. With this in mind, it becomes even more important the teachers are able to reach each and every student in the mathematics classroom as the students’ results on the tests can and will make.

The effective teacher needs to focus on the students who are the least interested in the content as they are the one who need to be motivated and encouraged to explore the topics being presented. Teachers should not just develop ideas of special topics which are of interest to the teacher

but on techniques from which motivational activities for most all mathematics lessons can be drawn.

Although Posamentier and Krulik do not define motivation in a dictionary form however, they give many techniques how teachers can utilize to motivate their students and peak the students' interest in a world of mathematics which is one many students really do not want to enter.

There are two general types of motivation, intrinsic and extrinsic. Each method has a very important part in the motivation of students in the mathematics classroom. Extrinsic is outside the person therefore it will be in the form of rewards, tokens, special privileges or other things which are not in the student's control. Extrinsic motivation methods are usually much more effective on the younger student. Extrinsic motivation usually results in something the student can actual hold in his/her hand. Intrinsic motivation is from within the person. The student may be one who strives for task-related goals or even to out-perform peers therefore seeking an ego related goal. Many times the intrinsic motivation may be as simple as a few words of comments from a teacher or peer. However, the student's earlier experiences have a great influence on the degree how much either type of motivation is valued.

The teachers' task or even tasks is/are to capitalize on the students style of learning and the method of motivation which compliments that student in order for the student to reach his/her ultimate goal of becoming a success and happy student of mathematics. The first few minutes of each class at the secondary level are usually lost while the teacher attends to administrative tasks. By the time these are finished, a poor tone or atmosphere has been set and will be difficult for most teachers to toss aside. This tone will be a major barrier for make professionally young teachers who may be lacking the ability to get students involved in the lesson after this down period. In an effort to transition from the down time while the teacher is doing the boring administrative tasks to the lesson, many motivational (not tricks) ideas can be incorporated into the classes to help the students not only enjoy but to be successful in the mathematics class.

There are nine techniques discussed in this book to motivate secondary students in mathematics. After each technique is discussed, numerous sample lessons with

multi illustrations are given to show how each technique can be used. The authors go far beyond just telling about using this idea to motivate students to learn. They actually show the 'why' in very clear illustrations. The authors only have a short narrative in each chapter prior to the ideas to motivate the students. The main focus of the book is to introduce the teacher (especially the professionally young ones) to ideas to captivate the secondary mathematics student to the point that he/she is open to exploring the wonderful world of mathematics.

Motivating students are many times the most important concern when preparing a lesson. When students are interested, they become receptive learners. Many of the technique examples could be easily adapted to middle and even elementary school.

The techniques are:

1. Indicate a Void in Students' Knowledge

This technique makes the student aware of a gap in their knowledge thus hopefully making the student develop a desire to fill that void. There were numerous examples of activities for the secondary students. The activities were to grab the student's interest. Almost any student in the class would have the background experience to begin and work with master the first few minutes of the activity. The student would have a positive feeling that he/she could master the problems thus making him/her eager to participate. After a couple examples are presented then a 'but what if type' question is presented.

This technique involves having student be aware of their weakness and capitalize on their desire to learn more.

The teacher is showing the students different techniques to discover how to solve problems. The student is the one who discovers his/her own weakness rather than just getting a paper returned covered with red marks or the teacher preaching some abstract ideas which have absolutely no value or meaning to the student. Students have a natural desire to want to finish a task and to understand their weaknesses. The extrinsic motivation plays a big part in this technique thus helping to motivate them to finish the task. This type of classroom where the student is very involved in the lesson will almost become a

magic show for the students as they will be so eager to go to the next level of their mathematics experiences. This technique is heavily laden with ‘what if’ type questions and situations. The student is challenged to think in higher order thinking skills.

2. Discover a Pattern

Mathematics has long been known as a language of its own. Within this language is a very distinct order. Few aspects of concepts are not in alphabetical order or something of that nature. Mathematics lets the students feel they are bringing something into the work.

Mathematics is a constant continuum in learning, the student is definitely not a product of Locke’s theory or *tabula rosa* (blank slate). Students learn patterns from birth and continue to add more patterns and patterns solving theories to their repertoire as they move through their life’s mathematical journey. New concepts can be made accessible from previous knowledge and if the teacher can set up a task where the students find a pattern, this could cause motivation for the students to continue learning. The realization of the student’s own ability is essential for the improvement of understanding and cognition. Setting up situations where students can find patterns can be very motivating.

Children are taught to work with patterns as mere toddlers when they are sorting candies and toys. As the child grows and enters the classroom, he/she will be introduced to more and more patterns. Problems to encourage pattern discovers are excellent motivators to teach patterns and mathematics in the classroom. Once a specific pattern is taught, students should be able to identify and solve similar problems in the future. Teaching students to find a pattern in a problem helps them to become more motivated to do more. This becomes that endless circle as the motivated students is able to solve more problems and the more problems the motivated students solves the more motivated he/she become.

This chapter has many very good motivational activities for all levels of the secondary mathematics student and many of the activities could be modified to create excellent motivational activities for the younger, upper elementary and/or middle school, student.

3. Present a Challenge

Being given an intellectual challenge that requires perseverance and cleverness is a very rewarding experience. Offering challenges to students will motivate them to solve the problem. Beginning with challenging problems also offers motivation when it leads into the lesson of the day. Be sure the motivational activity will result in the students being ready, open for learning and even on the edge of their chairs for the lesson of the day. Do not have a motivational activity that is fun but does not lead to the lesson. You do not want to just be providing bits and pieces of mathematical trivial but your motivational activity need to have a place in the schema of the mathematics learning for the day.

Teachers often find that allowing students to work in small groups of two or three on the challenges is very beneficial. Both other research and the authors of this books state that larger groups (four and larger) are not productive as the students have a tendency to either sit passively or let others do the work or even focus on other activities. In the small groups the students are able to do great amounts of work such as brainstorming and asking each other ‘what if’ type questions. They are able to do this in a much shorter time than when working as an individual. Many of the activities in this chapter will be excellent to teach some basic number theory such as order of operations. There are two activities on the value of π which will have the students posing many questions but will have them convinced at the end of the lesson. The term π will no longer be abstract or vague

4. Entice the Class with a “Gee-whiz” Amazing Mathematical Result

A natural way to stimulate interest in math is through our curiosity. A teacher can choose an illustration of an easily understood situation that leads to an unexpected result leaving the kids intrigued which then leads to them being motivated to continue. A short, easily solved problem that doesn’t distract from the lesson is best for this method. Some of the old problems which have some surprising results can create interest in the topic when the student wants to strive to prove this belief. These ‘gee-whiz’

activities while they create doubt that the proposed answer can be possible, lead the student to seek the correct answer but at the same time prove that what he/she believe at first impression is correct.

The chapter has many problems to create a challenge to the students. Most of these ‘gee-whiz’ problems are so amazing that the students will do the problem over and over as he believes that surely he/she did a step incorrectly. After numerous times trying to solving the problem and getting the same results each time, the student will finally agree the solution is correct.

There are numerous examples included in the book including patterns. This chapter is especially needed by students as they embark on standardized test which has a heavy emphasis on problem solving. If the student is introduced to activities such as these in this chapter, he/she will not automatically accept an just because it look right. The student will become much more cautious to be accepting. This caution with thus lead to the student evaluating each part of a problem before just taking any answer.

5. Indicate the Usefulness of a Topic

During the last few years, there has been a back to nature focus and to put a value on everything. An answer to the old question students have posed for years, ‘When will I ever use this?’, is trying to be answered. Students want to know the value of spending their time to learn the tasks. They do not want to be doing problems for the sake of doing problems. The usefulness of a topic can provide great motivation for students. When teachers can show the students examples of the values of the mathematics in their present and future experience, they students will be more accepting of these. The teacher and the student should be able to select mathematical applications that come from students’ experiences. Putting the personal will help the student to appreciate the value of the mathematics. Presenting mathematics which is used in an occupation can also be a motivating factor when students know the math they’re learning is needed to do that occupation. By knowing the students the teacher can help the students to become aware of the mathematics needed in almost every occupation or career.

This is the most important strategy to build motivation. students need to see how the concept being taught is connected to real life. If the teacher is not able to help the student make that connection, the motivation to learn from this focus is gone. Students and adults alike want to understand why they need to know something, not just what they need to know it for the test or because it is in the book.

6. Use Recreational Math

Sudoku has almost formed magnetism between the number problems and persons of all ages in recent years. Sudoku is an excellent recreational way to teach problem solving in the classroom. Many people like to play various number games. The success in puzzles, riddles and other mathematical problems can build a great motivation for the student in his/her the math lesson. Other games such as ‘guess my number’ incorporate algebra, basic operations, etc to help the student realize that mathematics can be fun when presented in the properly even in the context of a mathematics class Brief and enjoyable activities which flow with the theme of the lesson can be a superb introduction to the appropriate lesson (Patton & DeLosSantos 2012). By using these fun activities to introduce various (and appropriate) math lessons can have a lasting effecting on students?

According to the authors (p. 60), “Ideal recreations are those that appear difficult and yet are surprisingly simple to resolve”. They further believe that many adults have a mental sanctuary for the fear of and/or dislike for mathematics mainly because their own teachers only believed that mathematics should be taught without any motivational instruction and/or recreational techniques.

The mathematics teacher must exercise special care in the assessment of the students’ emotional maturity when selecting the (recreational) motivational mathematics games. The motivational activities provided will be excellent as introductions for algebra problems. There are others which can be used with problem solving activities. Overall the use of games in the mathematics classroom can win over the uninterested and dilettante student to become motivated to put forth effort for an upcoming lesson.

7. Tell a Pertinent Story

Who does not like a good story? Mathematics students like stories, too. However the stories told in the mathematics class must be carefully selected if they are going to accomplish the mission of helping the mathematics student by motivating him/her in the study. Many of the stories seem to have a trick to them when in reality it is the art of listening ever so carefully and then being able to do the operations to resolve the situation. Usually the stories seem to be so complicated as they are multi-steps involved and not a straight forward solution. These humorous stories which have a mathematical connotation allow equations, formulas and symbols take on a totally different meaning. As a result, the students develop another way to their ability to remember these concepts. Students also learn that while it may appear easy, the story might be very difficult thus allowing the students to realize why some mathematicians may devote their entire life to the resolution of a single concept. Becoming a natural storyteller is a talent that one must hone with time, however, as the talent is being developed one must practice many of the fine points of storytelling. First the storyteller must be comfortable. If he/she is going to be comfortable, he/she must know the theme. The effective storyteller will be able to tell the story with enthusiasm and make pauses at the appropriate times. When selecting a story, one must be careful of the age of the audience, when a story might be entertaining to one group, it might be considered silly to another group who is just a little older.

8. Get Students Actively Involved in Justifying Mathematical Curiosities

Mathematical curiosities are able to generate an interest in the mathematics student. These curiosities are often found in recreational books and magazines as well as on the internet. “Why does this happen?” is a question that appears to be a leap from the problems. It is important that the curiosities be kept short, generate interest and not dominate the lesson.

This strategy or technique is not as easy to locate or develop examples as some of the others however; it is well worth one's time and efforts. The book includes a few

examples which would be more difficult to modify for elementary or middle school classrooms than techniques.

9. Employ Teacher-Made or Commercially Prepared Materials

Many students need a “hands-on” approach to generate interest and comprehend what’s taking place.

Manipulatives can be used to build interest and help students gain an understanding of the concept. Computer programs can also motivate students to learn math.

Materials to use could be geometric shapes, geo strips, overhead transparencies, or other devices that illustrate a specific principle. Students can become inspired by cleverly chosen materials.

A student taking a hands-on approach in the classroom is so important for making connections and for motivating him. It’s very unlikely that students will sit for an hour and listen to the teacher talk and become intrinsically motivated to learn. They need to manipulate items and be allowed to take their learning to another level.

In conclusion, one must remember if you are to motivate the students you must have enthusiasm, knowledge and honesty. The first two are fairly easy to understand however, honesty might be the most important of all. If one misleads students with the purpose of misleading them the students will know it. If one does not know the answer to a problem, one must admit it and discuss with the students about seeking the solution. Let the students know that while the teacher does have more experience with mathematics than most students it is possible that he/she does not know the answer for every question posed.

Overall this is an excellent book and one all mathematics teachers should read and re-read. Most likely every time it is read, the reader will learn an additional bit of information. The book is indexed by topic and important mathematicians. In this light, I will say it has been one of the most difficult book reviews I have ever written. Every time I look back into the chapters I find more wonderful mathematics teaching information and felt I needed to go back to add to the review. I would give this book a rating of 5 on a scale of 1-5. It is a ‘must have’ for every mathematics teacher’s library.

About the Reviewer

Barba Aldis Patton, Ed. D, is an Associate Professor of Curriculum and Instruction in the School of Education and Human Development at the University of Houston-Victoria, Victoria, TX USA. She was the recipient of the university's Outstanding Service Award in 2007. As a former school administrator she has directed her research interests toward teacher quality, educational equity, mathematics education and online education after moving to the university level. She was a regional director for the Texas Council of Teachers of Mathematics, a member of the board of directors for the American Association of Mathematics Teacher Educators, served on the Texas State Mathematics textbook selection committee, on the state committee to review the 'End of Course Algebra II' items. Presently she is the newsletter editor for the American Association of Mathematics Teacher Educators, on the board of directors for the National Social Science Association and serves on the state math collaborative. She is coordinator of the TExES Academy (formerly Center for Academic Excellence) at UHV.

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