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WHAT IS MATH ANXIETY?

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- Webster's New Word Dictionary explains anxiety as: "1. worry or uneasiness about what may happen, 2) an eager desire [anxiety to do well]".
- Fear is a natural human characteristic and can easily be "learned" over time when facing math problems that may cause one to stumble when challenged. These can be "overcome" by taking **CONTROL** of the situation. Once the problem is "understood" by administrators, then it can be managed in the classrooms effectively. Passing grades can **INCREASE**, while drop out rates will take longer to manage, until students are made to realize that they must change their belief system about Math.
- Most people don't seem to be very comfortable with Math. People take it in continuing education, college courses and university courses only because they have to. The drop out rates according to the INTERNET can be as high as 50%, or more. On April 6, 2009, the Toronto Star (pg A12) stated that "Traditionally, the first semester success rates are usually quite low" and went on to say that the "younger students are struggling with Math". It seems that if the "**rigor**" is increased in a Math course, then one can predict higher drop out rates in that course. Some institutions may frown on this data and assumes that the professor is the problem and even try to present the Math course in a "less rigorous" manner, giving the students "practice tests", before the real test to ensure higher passing rates, etc. How does this prepare the student in Math? How does this ensure that the student can defend his/her solution? What about aspects of "safety" in a given design? Mathematics is the **primary language of technology** and it is essential that our Math professors encourage the necessary "rigor" to ensure the students are competent in the use of the Math to solve everyday problems, and design issues. Students drop out of Math courses for many reasons, the biggest one being "Math Anxiety". Some other reasons are a) being poor in reading and comprehending, b) the perception of "looking foolish" in class, c) having poor communication skills and the "fear" to ask for help, d) lack of funds to purchase texts, etc. , e) being tired in class (if one works all day) and falling behind, etc... The list is endless.
- **Drop out rates in courses that have no exams at all:** The author of this paper has seen **simple** courses like "Construction Estimating", where the hardest Math concepts introduced where to find the area and volume of a square, rectangle, or circle, seemed to produce very high drop out rates among students. These rates increased when the "simple math" was introduced. The students didn't have to "prove anything" to the instructor – in the form of tests, but dropped out mainly because they felt it was too complex and that they required Math classes to handle this. So if a course like this, offering little "**rigor**" with no testing, has high drop out rates, what can we expect in a Pre – Technical Math course that should promote "**rigor**" and test often?
- Technology is growing **exponentially** and the data seems to indicate that Math will be "demanded" in all disciplines in the not so distant future. Students can expect that the information given in their courses will be obsolete by the time they graduate. So what can we do? We can ensure that these courses contain a "**rigorous**" Math component where the students do not rely on one text book (but are taught to research many), since Math is the one subject that will not become obsolete as technology advances. As a matter of fact, it will be required more, or DEMANDED more in the future.
- Pre – Technical Math, or basically High School Math is the area where much of the problem lies. It is the **BASICS** that a vast majority of people lack. It is "very difficult" for most people to go to a Pre-Technical Math text and just brush up. The problem is a) understanding the concepts, b) understanding the symbols, and c) being able to solve and get enough problems right to increase confidence. As a result people give up. This is where **MATH PRO** or **MATH MAT** is extremely beneficial. (see benefits for software below).

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- **What do you actually fear?** When it comes right down to it, many are "anxious" about **LOOKING FOOLISH,** or being labeled as "stupid" because they cannot solve the *most basic math problems*. This anxiety is irrational because anyone can do very well at math with a) the proper tools and b) taking the time to "make the mistakes" and find out why? And taking the time to "**re-solve**" the wrong problems. If students are afraid to ask questions, then they cannot get the help they need.
- Math anxiety translates into "math avoidance" which can be an extremely dangerous problem if one is working in a technical field. Mathematics is the language of technology and is the only real way one can **PROVE** that a design is safe. Many schools are setting up courses in "Pre-Technical Math" to try to head this off, but are finding that a percentage of these students are still dropping out because this "math anxiety" can be devastating in a classroom environment. The instructor in these courses must make the students feel at ease. He/she must be very well versed in the mathematics topics and be able to solve **ANY** question from the text *in a step by step format* on the spot. Without this, the students will not feel confident in the instructor. Also, the instructor must **NOT FEAR** making an error, as this will demonstrate that errors are normal and happen to everyone. However, all of this will still not stop some people from dropping out. This will require a change in belief.
- One of the biggest problems in a classroom setting is the testing of the students. Instructors may give a series of quizzes and tests to determine competency. This is expected. However, as the students try these and FAIL, they become "anxious" about how they look to the other students and the instructor [especially if they had tried a university math course before, but require another Pre-Technical course to get into a wanted program]. Many students do not have the time to solve "hundreds of problems" and consequently will **not** develop a) the confidence and b) skill to solve the test problems in the set time alloted.
- Mathematics cannot be learned by memorization. It is a subject that requires ***much rigor*** and a complete understanding of the fundamentals. The **Yerkes Dodson Law** http://en.wikipedia.org/wiki/Yerkes-Dodson_law basically states that the maximum, or optimal degree of motivation for a given task seems to decrease with the complexity of that task. In other words, people with "math anxiety" will have a very low motivation to fix the problem and will tend to drop out of courses where "**rigor**" is involved. This is where **MATH PRO** or **MATH MAT** is extremely beneficial. (see benefits of software below).
- **What are some of the causes of this math anxiety?** There are many causes for this and some relate to how the student was treated at home, or by some elementary school, or high school teachers in their past, etc.. Some of these can be illustrated as 1) the attitude of society towards mathematics. 2) the attitudes of some technical non–licensing associations who do not encourage professional development in math. They may feel their code of ethics is adequate to make one upgrade themselves, but members may be using computer programs to avoid hand calculations in some designs. Licensed Professionals, on the other hand, for the most part, realize they cannot design anything and prove their designs are safe without an ***excellent grounding in mathematics*** and by verifying that the magnitude of the solution makes sense for the constraints imposed in the design. 3) the methods used to teach mathematics in the classroom – many institutions are using a power point approach, or where students follow on a laptop. 4) the depth with which the topic is covered and the required rigor to ensure the topic is understood. 5) Peer pressure. 6) Students writing technical reports are often taught how to write the report without any consideration for the technical data, equations and codes, etc. A technical report often requires a "proof" that a design is safe and meets various codes. Without the mathematical component, the student is not aware of the importance and consequences of this part of the report. 7) Poor reading and comprehension abilities, and 8) Poor communication skills.
- Many students feel that math is not a fun topic. They often feel it is a struggle to get through the math text and often have trouble with the different symbols used by various authors on the same topics. All of this contributes to the frustration. It then takes students **A LONG TIME** to solve one problem (even with a calculator), let alone hundreds of problems. So, they often give up and **drop out**.
- Many students have a big problem with the calculator itself. They find they are not able to understand the functions, or how to enter the data in order to obtain the correct result. These same students seem to master cell phones, digital cameras, and video games etc. It all goes back to **Yerkes – Dodson Law**

(see above). The calculator is a vital tool that students must master and many math texts illustrate the key strokes when solving problems. The big problem is that calculators are different and they do not have the same functions. They may not work the same way as described in the course text. This adds more frustration when trying the examples and problems in the course text.

- **So how do we fix the problem?** a) Society must encourage the learning of mathematics – in the news, and magazines, etc. b) technical non-licensing associations must encourage professional development in math and write about it in their magazines. c) students must learn the "fundamentals" of math and how to apply them to a wide variety of problems, d) students must be encouraged to **VERIFY** and **CLARIFY** all calculations by hand (especially in situations where designs affect the safety of the public). e) students must be able to understand if the magnitude of the answer makes sense and to be able to estimate a solution. f) students must be able to use calculators and technical programs to solve problems always being able to ensure that their answers are accurate. g) students must be encouraged to produce technical reports that illustrate the rigor of the theory utilized in the proposed solution. h) instructors should be Licensed Professionals (relating to math in technical programs) who have a **strong grounding** in all the math topics taught and promote "**rigor**" with extensive testing. i) students must be taught to develop equations from first principles and how to ensure they are correct. j) Students should be encouraged to develop spread sheets (using Macro,etc..), or small programs that make the topic more interesting. This will generate confidence and allow the students to "what if" the equation tested and then determine the **limits of that equation(s)**. k) students should be "introduced" to ethical problems relating to the lack of verification of computer generated solutions. l) students must learn **NOT** to rely on one text, but to be taught how to research many texts in libraries and online.
- **So how do we fix the problem in the colleges and universities?** The headlines in the Toronto Star on 6 April 09 (Section A) read "Profs blast carefree frosh". The article stated that "more than 55% of Ontario's faculty and librarians surveyed believe that students are less prepared for university than three years ago". So how do you think these students will make out in courses where Math "**rigor**" is expected and enforced? How will this effect the drop out rates? The article states that "professors don't think they have the needed critical thinking or math skills, and they lack the ability to learn independently". This is a huge problem and will be in **DEMAND** in the very near future. So what can the colleges and universities do? a) Ensure that students taking technical courses and math courses know "**up front**" that these courses will require a lot of "**rigor**" and problem solving. b) Reduce the drop out time for students in these courses, so they are responsible for their desire to pursue a higher education and that it takes a commitment. c) Encourage courses that require more SELF STUDY. Math courses in particular, where students are given general instructions on a topic, but must research and solve many problems on their own. d) Encourage testing using problems "not seen by students before", helping them to learn which concepts can be used in a particular situation. e) Encourage problem solving based on first principles in all Math courses, as this is the language of technology. **MATH PRO** or **MATH MAT** is extremely beneficial here as Pre – Technical topics can be used and referred to quickly with any text until the fundamental concepts are mastered. Then it can be used as a "brush up tool". (see benefits of software below). See how to fix the problem? (above).
- **Self Study Correspondence Courses:** Students should be encouraged to take a Self Study Correspondence Course in Pre – Technical Math where the "rigor* is expected on any test, or exam. This will enable students to progress at there own pace and learn how to study on their own.
- **Check a few movies (true stories) that illustrate what good teachers can do:** a) "**October Sky"** for example, is about a teacher who helps a student follow his dream and gives him a text on higher level Math to help him, and b) "**Stand and Deliver"** - is about a Math teacher who beats administrative odds at east Los Angeles' Garfield high. He refuses to write off these students as losers. Two good movies that may inspire you to "follow your dreams", regardless of the odds. The good Math instructors and professors will do **ANYTHING** to help their students. They are hampered by administrative problems.
- **A responsibility to promote "safety" in technology:** College and university professors in Math are "generally" Licensed Professional Engineers and must adhere to a higher standard. They must ensure that their students are prepared to face the future. Since design is primarily Math intensive, they must ensure that the students are able to produce "safe" designs, using Math concepts that are correct. They

cannot be worried about drop out rates, or failure rates (assuming they have done everything humanly possible to encourage and help the students). Some administrators may not be aware of the importance of any given Math course in the scheme of things. Many students still believe they will never use Math again, once out of college, or university!!

- Math anxiety is found at all levels of mathematics, but in areas where the "theory" presented is used in design situations, we must exercise due diligence in the classroom to ensure the student is aware of the consequences of using mathematics in design scenarios.
- Some contractors are designing decks *without an understanding of the mathematical concepts*. They then build these decks without any worry about the permits, or application of Codes. Some of these decks **FAIL** and kill people. This is only one small example where a deck is considered by many as a simple structure. In many areas, depending on the design, a Licensed Professional is required. This is particularly true where this deck is used by the public. But what about that small deck in the backyard? A party may be held on this deck. What does the contractor say when this **FAILS** and injures, or kills someone? It's too late then. Some are saying deck failures are on the increase!
- Mathematics is the language of technology and if we do not understand this language we will find many poor and unsafe designs. We must look at math as a **BENEFIT** and use it wherever we can to **IMPROVE** the design process. There are contractors, technicians, technologists, managers and even engineers who are using computer programs without **VERIFYING** that the magnitude of the answer is correct. Often, designs are not looked at very closely until a failure occurs, or a lot of money is lost in remedial work. We must encourage students to study math without being "afraid of making mistakes". Making the mistake is not the problem. The problem is not being able to recognize that mistake and be able to correct it. It's not being able to establish if the magnitude of the solution makes sense. All of these things can easily be worked in the math program so the student understands what these solutions "can mean" in a design scenario.

Search ***Deck Failures*** On The Internet As One Example Where Math Is Not Properly Utilized.

BE A WINNER – MASTER THE MATHEMATICAL CONCEPTS THAT WILL GET YOU TO YOUR DREAM.

DON'T BE AFRAID OF THE "RIGOR" INVOLVED. EMBRACE IT AND SUCCEED. YOU WILL BENEFIT IN WAYS YOU CANNOT UNDERSTAND TODAY.

THE JOBS OF THE FUTURE DEPEND ON THIS KNOWLEDGE TODAY. TECHNOLOGY IS CHANGING EXPONENTIALLY, SO BE PART OF THE SOLUTION.

FIND A GOOD SCHOOL THAT PROMOTES THE "RIGOR" AND HARD WORK, AS THIS WILL BE YOUR TICKET TO SUCCESS.

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33 REASONS TO PURCHASE OUR MATH PRO AND MATH MAT SOFTWARE.

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See **MATH PRO** PDF on website. Describes Contents of Software.

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