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Measurement that Influence Mathematics Teachers' Integration of Teaching Methods on Student Achievement in China

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Abstract

While many studies describe the use of teaching methods in the mathematics classroom, few explore the factors that influence teacher decisions around its use. Research in teachers' knowledge for teaching mathematics has been gradually growing for the past several years. The problem that many students have is that they don't know how to study maths to get good understanding of the subject as a result of various reasons. We take the major in mathematics as an example, designs some classes of new teaching methods with the diversified assessment to cultivate students' innovative thinking, providing a reference for the other students. With various conceptualizations about what teachers need to teach mathematics, the present study hence will try to identify a few vital observations of the years and try understanding the problem from a 360-degree viewpoint. And considerations for mathematics teacher education are discussed.

Keywords: Teaching methods, Innovation, Conceptualizations, Mathematics.

Introduction

Mathematics is a subject that every student has to study at one time or another. The paradox lies in the evident truth that some enjoy the subject but the mass majority simply hate maths. In our over 20 years as the Math teachers combing through the various academic levels from basic, through secondary to the university levels, we have observed that the importance of maths for students has never been more prominent. Over the years there has been serious decline in the overall performances of students in Math (and Science) as a result of uncountable factors and this has affected teaching, learning and interest in this subject(s). Per our experience as a teacher, we will like to attempt some of the challenges we have observed and encountered over the years. Most educational courses include some level of maths while almost every profession uses maths in some form on a daily basis. In this paper, we reviewed various conceptualizations of teacher's mathematical knowledge for teaching, and existing qualitative and quantitative studies about this relationship (Figure 1).

The paradox

As the two young boys growing up in the 1970s, we were made to believe that Math as a subject was reserved for the "specially inclined". We were made to believe that we were not fit to pass some subjects like math and science due to setbacks in our initial stages of our educational stage. It wasn't until far later in my advance academic stages that we broke that jinx and loved the subject. We should say that it wasn't

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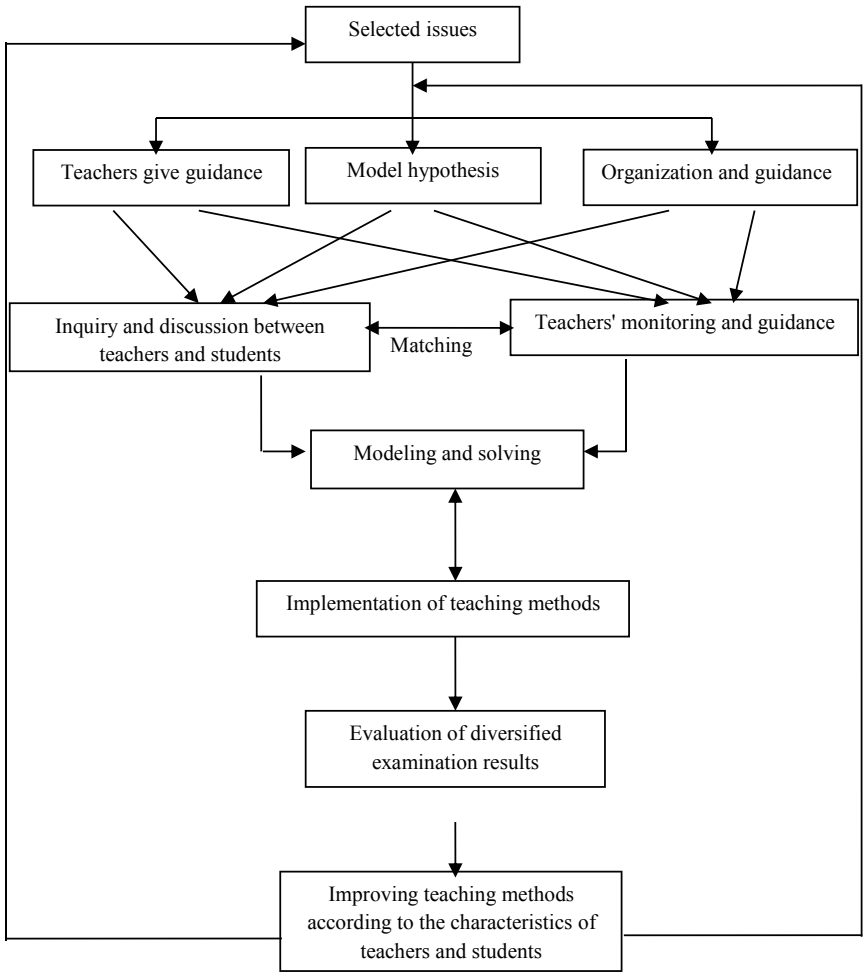

Figure 1: Flow chart of teaching methods and diversified.

easy doing so, since our foundation to the subject(s) was/ were deeply broken psychologically, hence a burden of inadequacy we carried all through our lives until the day we broke through that. The central implication is that interventions in mathematicians' teaching must take into account the possibility that it may be just as important to improve confidence and resources as it is to change values. This is just a life story of the truth of the foundational setting of the study of math in today's China.

We were just two of the millions of children that were crippled from the very start of schooling with this fear of the subject. We are just wondering the millions out there that might have lived their entire lives with this and might have even gone to their graves with it. Reflections over the past today, reveals amongst other things, three critical reasons for this phobia for math: The student, mathematics and the teacher.

EXAMPLES

Example 1. In order to determine the *n*-th roots of unity, we write

$1 = 1\exp[i(0 + 2k\pi)]$ $(k = 0,1,2,\ldots, n-1)$

and find that

$$1^{1/n} = \sqrt[n]{1}\exp\left[i\left(\frac{0}{n}+\frac{2k\pi}{n}\right)\right] = \exp\left(i\frac{2k\pi}{n}\right) \quad (k = 0,1,2,\ \text{n-1})$$

When $n = 2$, these roots are, of course, ±1 ; When $n \geq 3$, the regular polygon at whose vertices the roots lie is inscribed in the unit circle |z| =1, with one vertex corresponding to the

$$principal\ \text{root}\ z = 1(k = 0)\ \text{if we write}\ \omega_n = \exp i\left(\frac{2\pi}{n}\right)\ \text{it follows of}\ e^{i\theta}\ \text{that}$$

$$\omega_n^k = \exp i\left(\frac{2k\pi}{n}\right)\ (k=0,1,2,\ n-1)$$

Hence, the distinct *n*th roots of unity just found are simply 1, ω_n, ω_n^2,...., ω_n^{n-1} . In Figure 2, the cases *n*=3,4, and 6 are illustrated. Note that $\omega_n^n = 1$.

Teachers were randomly assigned to treatment and control groups. When the treatment groups determine the *n*-th roots of unity, the control group spent time on the regular mathematics instructions.

Example 2. Prove that a composition of continuous functions is itself continuous. **Proof.** We let $w = f(z)$ be a function that is defined for all z in a neighborhood.

$|z - z_0| < \delta$ of a point z_0, and we let $W = g(w)$ be a function whose domain of definition contains the image of that neighborhood under f.

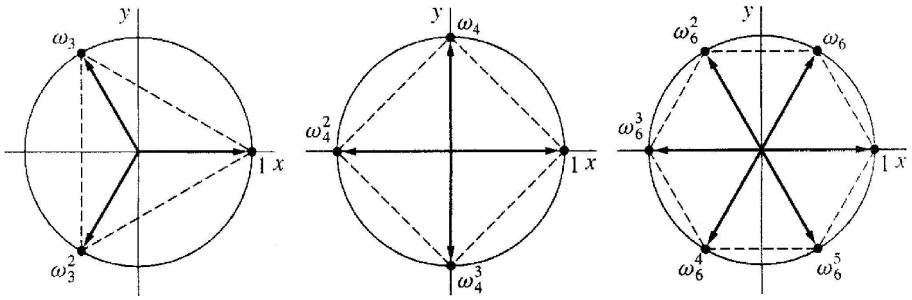

Figure 2: The cases n=3,4, and 6 are illustrated.

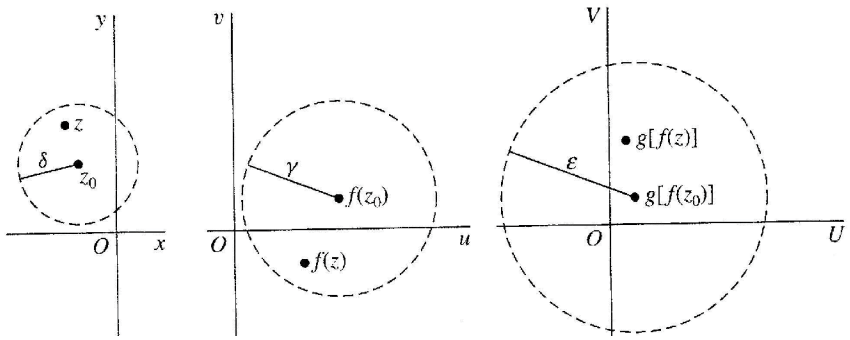

Figure 3: The continuity of g, z_0 and W.

The composition $W = g[f(z)]$ is, then, defined for all z in the neighborhood $|z - z_0| < \delta$. Suppose now that f is continuous at z_0 and that g is continuous at the point $f(z_0)$ in the w-plane.

In view of the continuity of g at $f(z_0)$, there is, for each positive number ε, a positive number γ such that $|g[f(z)] - g(z_0)]| < \varepsilon$ whenever $|f(z) - f(z_0)| < \gamma$. (Figure 3) But the continuity of at z_0 ensures that the neighborhood $|z - z_0| < \delta$ can be made small enough that the second of these inequalities holds. The continuity of the composition $W = g[f(z)]$ is, therefore, established. This completes the proof.

Finally, it is worthwhile observing that if c is any particular nth root of a nonzero complex number z_0, the set of nth roots can be put in the form $c, c\omega_n, c\omega^2{}_n, \ldots\ldots, c\omega^n{}_n\omega^1$.

Students find that adding and deleting the arguments are very useful. This is because multiplication of any nonzero complex number by ω_n increases the argument of that number by $2\pi/n$, while leaving its modulus unchanged.

The above two examples prove to be a valuable tool for teaching students how to study mathematics.

Demystifying the Math Language

We have observed over time that students get uncomfortable and confused by basic mathematical words like factorize, multiples, divide, ratio, subtract, LCM, HCF, square, square root, evaluate, simplify, volume, yard, cubic, power, area, just to mention a few.

Lack of understanding of these mathematical terms seriously militates against the students' abilities in understanding terms and to focus on their problem-solving instincts.

Unfortunately, they tend to just memorize these terms without knowing their meanings, for the sole purpose of passing their exams and thus, defeating the very basic purpose/ lifelong effect of teaching the subject.

Mental capabilities

In order to make the innovation of new teaching methods to a new level, we have created 24 kinds of new teaching methods, such as "CT&CL (Collaborative Teaching & Cooperative Learning) teaching method" and "Based on Our Features" teaching method [1].

Due to the stigma attached to the subject matter (just like in our own cases as a child) even though one may be brilliant, the student doesn't believe in the possibilities of making it through the subject. Students believe that failure is related to the lack of academic intelligence. If per any instance there is a high score in examinations, these students perceive their success as accidental, and this makes their progress further rather take a wrong turn. The subject(s) is/are therefore approached to pass through luck, not understanding, in doing so; they limit their capacity to study and move ahead. Most students therefore lack well-developed mental strategies for remembering how to complete simple mathematical questions and combinations of basic facts even when they have been taught strategies.

Curricular

We personally don't think the current curriculum of the Chinese Education Service provides opportunities for students to properly deal with content and develop well. That the student becomes proficient and experienced in mathematics, it is critical that the same content not be taught year after year. The curriculum is not reviewed to

correspond to the dynamic and ever mobile changes of the world now. Students who do not understand the subject are likely not to get it because it's the same mode and state. It limits opportunities to reason and solve problems totally. Nothing changes to improving to the next level as the same text is taught several times over and over the years in the same usual manner. This rather narrow view of mathematics breaks the very foundation and lowers the level of interest of students.

Teaching & attention

Related to the above are the modes and methods of teaching. Here in China, students most times have difficulty focusing on multistep problems and procedures due to how the subject is being presented to them, which indeed has interfered with their progress rate. On the average, students are normally slow in understanding the subject, hence effective teaching skills like drawings, illustrations and learning aids must be adopted to brighten up the picture. We have realised that making the students work in pairs to help each other stay on task really helps; a peer review strategy we have used over the years to effectively bring out the best in my students [2]. And maths requires time, consistency and patience to master.

The Source

It is clearly an undeniable fact that students do not regard mathematics as a viable profession in China. On the contrary, they see it as a pre-requisite to gaining entry into programmes that lead to other academic designations, hence "survive" the course for the sake of exams. Indeed, this is evident that the influence of Math teachers does not go beyond the walls of the classrooms. Hardly does one call himself a Mathematician here in China, much as we hear of the Medical Doctors or Lawyers. This is sad indeed. The national culture of mathematics teaching in China, which is summarized below, mimics to a considerable extent, the general culture of teaching in China 's educational organizations.

Interactivity

In a typical Chinese classroom where Math is taught, students do not or are hardly encouraged to ask questions, especially if they don't understand something about what is being taught or need a little clarification. It is more like a crime for a student to suggest or make an add-on to what is being taught. The teacher assumes the role of the giver and the student, the receiver, hence the student's sole duty is to listen and take whatever is been poured out from the teacher. There is no or little interactivity. The teacher gives notes when necessary, and it is on the part of the student, the knowledge gained, if any, is stored in the dustbins of their brains, awaiting the day of exams where it is just offloaded unto the paper as presented, to the best of the students' ability and then quickly discarded from the brain. The teacher brands students who dare to ask questions or disagree to a particular solution of mathematical question "challengers" or a threat to his or her authority in the classroom. Such students would thus suffer undue harassment from the teacher and a possible isolation from their peers who might label them "too known"; a Chinese way of labelling a confident person. We can conclude hence, that this atmosphere of fear and hostility is not harmonious for effective mathematics learning. And it may be one of the greatest causes of mathematics underachievement in Chinese schools.

Fast track

In most cases, mathematics teachers enter the classroom and define a concept, work a few examples from a mathematics textbook and quickly conclude with an assignment from the book for the students to do. In other words, mathematics teachers act before a passive audience that is supposed to absorb the knowledge transmitted.

Teachers rarely link mathematical concepts to the everyday lives and surroundings of their students or cultural practices in their society, which would have rather given the student a better understanding since they are familiar with the scope of examples given. Mathematics is taught in vain and raw as if it has no social or economic referents or relevance in our society [3].

Memorization

Rules, formulas or algorithms are just lashed out on the students to use in doing assignments; what then is expected of the student but to "survive" exams and forget the subject as stated earlier above? Usually, the underlying reasoning of the formulas or algorithms is not explained to the students because either the teacher doesn't know or the teacher is not in tune with current trend of teaching models and practices or even worse, the teacher doesn't deem it necessary for the student to knowing these things. In fact, students are required to "chew and pour" out these rules and formulas during tests, quizzes, class assignments, home works, and examinations, per the current practices. It ends up then that, learning Math now becomes a matter of memorization than learning [4].

Practicality

Math as a subject is practical and demands learning aides during teaching but here in China, it is solely chalk and chalkboard. Mathematics is about quantitative techniques; geometry and the patterns of shape; motion and calculus; probability and chances; logical reasoning; and number theory. All these demands some form of teaching aids in one way or the other as per the level of education in perspective. This is alien to the Chinese mathematics teaching system.

The math language

I have observed over the years that the Math language being expressed in the English Language poses a huge problem too for students. What am I talking about? The students might not have gained enough proficiency in the English Language to better understand and interpret the mathematical ideas being taught efficiently. The teacher also may have difficulties expressing mathematical ideas precisely in English, hence breaking the communication gap. This leads to a situation of no idea transferred from the teacher to the student. Unfortunately, most mathematics teachers don't acknowledge this fact but assume once

students are incapable of solving a specific mathematical problem in a class test or continuous assessment, then they are either lazy or most likely it is concluded that students are unintelligent [5].

The brilliant student syndrome

One very popular challenge is the lifestyle of teachers who have a hidden assumption that only the most "brilliant students are capable of learning mathematics". This produces an uncomfortable atmosphere as the other students who experience challenges in understanding the subject are left behind to fend for themselves, while the so-called brilliant few are motivated by provision of extra assistance; the very opposite of that which should have been given to the students experiencing the challenges rather. When students do not or partially understand a teacher's method of teaching, the teacher rarely changes or improvises the method of presentation to suit that peculiar challenging circumstance(s). Instead, the teacher in most cases would blame the students for, not being smart, being lazy or not academically inclined like the situation in the previous point above. Thus, the students are forced to blindly learn the teachers' method whether it favors them or not [6]. Is that not a burden too huge to carry?

Conclusion

From the write up above as per our observations and knowledge in this subject, it is clear that if drastic measures are not taken to rekindle the passion for mathematic and more resources poured in to make it appreciated than it is now, not only the country but the whole continent will suffer as a result, since mathematics is the bedrock of Science and the world is soaring at an amazing scientific era now. We need to cultivate a new national culture to this. It should be a culture that must be transforming, reforming and revolutionary in order to build a strong national mathematics culture in China.

Math and Science are intertwined. A good foundation and command over Math is the trigger to a good Science student. Students tend to benefit greatly from using learning aides to practice their Math skills. It is a good idea to study with peers of the same interest and goals, where consultations can be done amongst them and ideas exchanged in learning and solving mathematical questions. A long-term effect of improved Math skills amongst them, which in turn boost the students' confidence and make them feel good about mathematics; an iron sharpeneth iron strategy of developing a positive attitude towards math [7-9].

Conflict of interest

We have no conflict of interests to disclose and the manuscript has been read and approved by all named authors.

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