FOOD FOR THOUGHT WITH FLAVOURS FROM ASIA

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This is a light hearted tour through a range of mathematics pedagogical activities and observations. These observations will be presented through the multiple lenses of different Asian countries. The tour will highlight certain topics and issues where pedagogical knowledge is essential in facilitating student construction of mathematical understanding and knowledge. Participants will be expected to be involved in all the activities and challenges, and their attitude towards the number system is guaranteed to be changed forever.

Introduction

It has been my good fortune to travel frequently to a number of Asian countries. While on these trips I have collected a number of oddities that have amazed and amused me. The Borneo daily paper was the source for the following interesting contribution to student mathematical learning (see Figure 1).

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Figure 1. Borneo Bulletin January 22nd 2001, p. 5.
This advertisement, I suspect, was a serious attempt to get people to exchange their money for the advertised but dubious attractions. This advertisement is trying to fill a need so what can we learn from this example?

A quick examination of the spelling reveals that the pills may have possibly selective effects on intellectual performance. Yet errors in English spelling and grammar are common in many Asian countries that struggle with the dilemma of whether to teach in English or their own language (see Figure 2). Some countries teach in English thus adding an extra burden upon their students whereas countries such as Malaysia teach only Mathematics and Science in English. The effect upon the student learning of these two subjects as well as the effect upon student English proficiency is unknown and is being carefully monitored.

Another aspect revealed by this advertisement is that like many countries in this region, Mathematics and Science are highly regarded. The importance of memory and the need to be competitive are also strongly represented. In a region where Singapore regularly comes first in the international mathematics comparison studies (TIMMS), the place of coaching or tuition schools is a well known component of their success. Or to keep in theme, Singaporean students are subjected at these after school centres to a steady diet of drill and practice and are force fed a bland diet of basics. The Singaporean teachers are challenged to provide the variety to the learning experiences at school in order to ensure that their students receive a balanced diet. Some teachers do not devote time to drill and practice at all, as they leave it to the tuition schools.

Figure 2. The difficulties of the English language.

Still, what is it in our past learning that makes people (and us) susceptible to these inflated and dubious claims? Is it a product of the collective unconscious formed by generations of mothers telling children to eat their crusts so that their hair will go curly, or that eating fish will make them brainy? Yes and is it really true that every reader wearing glasses should have eaten more carrots? Whatever the source of these beliefs, there is no doubt that for some people including teachers, they are very strong and have an influence upon their behaviour. A teacher’s behaviour contributes to the quality of teaching which in turn has been linked to successful student learning (Hill & Rowe, 1998). So this leads to an important question for every teacher.

Are you starving your students?
A highly regarded Victorian mathematics educator, who has had a significant impact upon mathematics education in Brunei, recently criticised the fare being dished up in
many of the classrooms and teacher education courses that he had observed. He was deeply disturbed by what he regarded as serious examples of cognitive undernourishment.

There is an urgent need to change school mathematics and mathematics teacher education in fundamental ways... Old patterns and methods are so deeply entrenched in many schools and teacher education institutions, and particularly in the minds of teachers, lecturers and students, that there is an urgent need to problematise existing practice and equip and empower practitioners to achieve change. (Clements, 2003, p. 638)


It encompasses the conscious and subconscious beliefs, behaviours and relationships that guide and control what teachers and students do within mathematics lessons. We could call it the classroom menu. Brousseau (1984) drew attention to how a teacher’s intervention could reduce a student’s role to answering a series of relatively simple questions, by ‘emptying’ the task of much of its cognitive challenge for the students. If the class had answered the questions, then the teacher tended to believe that the students had learned what had just been taught. The teacher assumed that if they asked questions that their students could answer, then the students would construct the “whole” from the parts. In that sense, the students were presumed to learn what they were expected to learn from the original question. Both students and teachers were happy because they had become accustomed to this menu of teaching provided by the teacher. Cognitively challenging questions were removed from the menu and replaced by bite-size portions. The seduction of behaviourism that promotes mastery learning and ‘breaking a long journey into small steps’ is still strong here and is evident in some (or all?) current forms of outcomes based education even though it has long been discredited. Is this what goes on in our classrooms? Do we starve our students by feeding them mathematics emptied of any cognitive challenge? Are we serving soft mash that is easily chewed and digested and totally leaving out the mathematical solids? If we are then although our intentions may be fine, what of the results?

According to Brousseau, when teachers adopt this style of elicitation in an attempt to help students to tackle higher-level mathematics tasks they deny their students the opportunity to formulate, and apply, strategies of their own. Cognitive load is reduced and usually the teacher who formulated the questions publicly decides on the correctness, or otherwise, of answers to the questions which he or she asks. This was an important common element of the didactical contracts identified in secondary mathematics classes in Brunei Darussalam (Clements, 2004, p. 14).

Ah, Brunei Darussalam classes I hear you say, surely it couldn’t happen in a wealthy country such as Australia. Why our land abounds in natures gifts of beauty rich and rare. Well after viewing the TIMMS videotapes of Australian Year 8 mathematics classes, a widely respected mathematics educator, Alistair McIntosh was moved to make the following comment:

What overall picture [do the lessons] give of a typical Year 8 Australian lesson? The teacher talks a lot, the students mainly reply with very few words, most of the time the students work using only pencil and paper, on a repetitive set of low level problems, mostly presented via the board or textbooks or worksheets, discussion of solutions is mainly limited to giving the right answer or going through the one procedure taught. There is little or no opportunity for students to explain their thinking, to have a choice of solution methods or to realise that alternative solution methods are possible; and
very few connections are drawn out between mathematical ideas, facts and procedures (McIntosh, 2003, p. 107).
This is a perfect case of cognitive starvation. Clements (2004) apart from being highly critical of such practices did provide some direction for change. He argued that it was only through a change in the traditional pedagogical practices that this forced starvation could be stopped.
Research indicates that if we are primarily interested in enhancing student learning of mathematics then improving teaching methods is fundamentally important. It is as important, at least, as taking steps to ensure that teachers accurately portray mathematical content and develop extensive knowledge of relevant content knowledge. No matter how much recent technology we employ, if our teaching is of the cognitive emptying/elicitiation/exposition variety (as so much teaching of mathematics is, in this part of the world), then our lessons will not help many students learn mathematics well. They may assist some students (especially high-stream students) to pass tests, but they will not be likely to generate relational understanding (even with many high-stream students). That will be true, even if the students, and the teachers, are happy with the ways the lessons proceed (Clements, 2004, pp. 27–28).
If this is not an accurate description of your classroom practices, then is the variety of pedagogical approaches that you are using providing a balanced diet? What has research to tell us about teacher pedagogical practices?

Do your students get a balanced diet?
A good deal of the early research into pedagogy was based upon a variety of assumptions. A common one was that teachers developed characteristic patterns of behaviour depending upon their classroom situation. These patterns may have been conscious and deliberately chosen, or have arisen from experience and may have been largely unreflected and unconscious. Such teaching patterns were often designated as orientations, styles or modes of teaching. Many researchers represented teaching styles upon a continuum with their theoretical opposites as end points. Some researchers used more than one continuum.

The aim of this type of research was either to present an overall structure for current teaching practice according to the researcher’s theoretical presentation, or to categorise teachers according to a particular theoretical orientation. The assumption was that all teachers could be located somewhere along the continuum. For example, Brady (1985) investigated this area of research and concluded that all the models could be placed upon a series of continuums with the end-points being: (a) teacher centred intentions and behaviour; and (b) child centred intentions and behaviour. A major criticism of Brady’s models was that the classification of teaching behaviour or intention by assigning them to a position upon the continuum did little to explain the totality of teacher classroom behaviour. As Brady acknowledged, what was lacking was a theory that considered how and why teachers behaved as they do, and what were the effects of that behaviour upon student learning. He saw these models as descriptive guides and not developed theories.

Another example is the model proposed by Ernest (1989, p. 199) and was based upon the use of authority by the teacher in the classroom and presented an authoritarian-democratic continuum. Another modern example of this type of research can be found in a study of the espoused beliefs of secondary mathematics coordinators from the perspective of a two factor model of ‘transmission’ and ‘child centred’ (Perry, Howard &
Tracey, 1999). While the beliefs uncovered were a valuable resource, the bi-factor approach ignored other possibilities. A final example of a more recent study stated the following:

To identify the extremes of teachers’ beliefs and to facilitate categorisation of responses, an artificial continuum of teaching and learning was used. At one end of this continuum, mathematics is seen as a fixed body of facts to be delivered by teachers and internalised by students. Referred to as a traditional teaching approach, this perspective is associated with individual student work, rehearsal of routine questions, and reliance on textbooks or worksheets. This view may be accompanied by a belief that problem solving is an end and that problems should be presented to students after they have mastered basic facts and skills. At the other end of the continuum, termed a contemporary teaching approach, mathematics is seen as a dynamic subject to be explored and investigated. Classroom practices associated with this perspective usually involve group work and the use of non-routine questions that promote mathematical thinking, and the development of problem-solving skills. This teaching approach may be accompanied by a belief that problem solving is a means to learning mathematics (Anderson, Sullivan & White, 2004, p. 40).

In the two latter examples and others like them there is often another unstated but automatic assumption that student centred pedagogy (or problem solving) is always best. Yet this is too simplistic and ignores the cases of student centred pedagogy existing in an intellectually undemanding or ‘emptying’ classroom. The equivalent using a food analogy is to categorise all teachers as ‘hamburger eaters’ and ‘not hamburger eaters’. All teachers must fit along this continuum. Thus some teachers may gorge themselves on fast foods whereas others are the consumers of considerable amounts of ‘honeymoon salad’ (lettuce alone). How useful is this continuum in reflecting what teachers really consume?

Why do we get seduced by these simplistic ‘solutions in a bottle’? Just as we would reject the Bruneian pills for improving mathematical performance (hopefully), our discussion of teachers and teaching, must somehow acknowledge the complexity of the process.

**The missing ingredient**

Fortunately there have been many attempts to provide the ingredients for successful classroom chefs who must constantly cook with in order to create the rich and varied diet that promotes growth in their students. Figure 3 illustrates one attempt and leaves space for a missing ingredient. What would you supply as the missing ingredient? In 1952 Cunday and Rollett stated that “Mathematics is often regarded as the bread and butter of science. If the butter is omitted, the result is indigestion, loss of appetite, or both” (cited in Ollerton, 2003, p. 57). Does the lack of one ingredient destroy the final dish?

A good chef knows that the success of the final dish depends upon the way the individual ingredients work as a whole. For the teacher it is the realisation that everything is connected. There is a need to dismiss the assumption that teachers use only one pedagogical style within their classroom or for that matter in any one lesson. The context of the mathematics classroom and the pedagogical strategies employed within are more complex than a mere choice between two extremes. Major longitudinal research coming from Singapore has revealed that experienced and successful teachers continually vary their approach where they ‘weave’ a number of different pedagogical strategies into their classroom (Luke, 2005).
These teachers present a healthy diet to the class by varying the ingredients according to the conditions. Thus a teacher doesn’t adopt one approach and stick to it, but rather adjusts the pedagogy to the multitude of variables that influence the classroom context in order to create conditions favourable to student learning.

Creating such conditions requires the teacher to recognize when it is useful to intervene, when to be strongly didactic, when to offer hints and advice and when to stand back and strategically decide not to ‘interfere’. Seeking to offer students choice in their learning inevitably means finding problems that encourage students to make decisions about how to proceed and about what approaches and what resources they might use in order to work towards a solution (Ollerton, 2003, p. 98).

An unfortunate side effect of this simplistic labeling is the effect that it has upon teachers. Being labeled as ‘teacher centred’ comes with a significant amount of shame. It usually carries the stigma of being a teacher who does not care for their students. Just as the label ‘burger eaters’ may attract the stigma of ‘unhealthy slobs’. This sort of labeling hardly contributes to an enlightening debate. In such an environment, obviously teachers will espouse what they need to in order to avoid being shamed and this difference between espoused beliefs and action beliefs has a long history in educational research (Argyris & Schon, 1974).

![Diagram](image)

*Figure 3. The missing ingredient (Ollerton, 2003, p. 3).*
Elsewhere I have argued that the value of studies of espoused beliefs is questionable in terms of informing teacher classroom practice (White, 2002). What are of value, however, are studies that uncover the belief basis of teacher classroom behaviour. The classroom chef, who uses the cognitive emptying/elicitation/exposition recipe, does so because he or she believes that this is the best way of assisting student learning. It is these beliefs that must be exposed and challenged before the classroom chef is likely to change recipes.

And what about a little spice?
Do you believe that mathematics is a subject that provokes hunger, passion and desire? Do Victorian students regard the staffrooms of mathematics teachers as kitchens of delight staffed by passionate expert cooks? Does this passion inspire the students to study further mathematics? The famous Danish writer, Peter Høeg is one who was inspired by his mathematics teachers. In one of his now famous novels, (some of you may regard it as a fantasy tale, because the male is doing the cooking), the main character is a female named Smilla. Because I wish to add some remarks, the novel quotations will be shown in italics (Høeg, 1992, pp. 121–122). To set the scene, the male lives in a ground floor apartment and has been watching this attractive girl from Greenland pass by his door each day.

Finally, he has invited her in for dinner, and while he cooks, they chat and she tells him of her love of ice, snow and mathematics. It begins with the Smilla, saying:

*Do you know what the foundation of mathematics is?’ ... ‘The foundation of mathematics is numbers. If anyone asked me what makes me truly happy, I would say: numbers. Snow and ice and numbers. And do you know why?*

How would you answer? How would you expect the man to respond? Well, he splits the claws with a nutcracker and pulls out the meat with curved tweezers. Undaunted she continues:

*Because the number system is like human life. First you have the natural numbers. The ones that are whole and positive. The numbers of a small child. But human consciousness expands. The child discovers a sense of longing, and do you know what the mathematical expression is for longing?*

Obviously the strong silent type, *he adds sour cream and several drops of orange juice to the soup.* She continues:

The negative numbers. The formalization of the feeling that you are missing something. And human consciousness expands and grows even more, and the child discovers the in between spaces.

*Between stones, between pieces of moss on the stones, between people. And between numbers. And do you know what that leads to? It leads to fractions. Whole numbers plus fractions produce rational numbers. And human consciousness doesn’t stop there. It wants to go beyond reason. It adds an operation as absurd as the extraction of roots. And produces irrational numbers.*

Overwhelmed by this insight *he warms French bread in the oven and fills the pepper mill.* She continues:

*It’s a form of madness. Because the irrational numbers are infinite. They can’t be written down. They force human consciousness out beyond the limits. And by adding irrational numbers to rational numbers, you get real numbers.*
She notices that he is listening (although saying nothing), so she continues:

*It doesn’t stop. It never stops. Because now, on the spot, we expand the real numbers with imaginary square roots of negative numbers. These are the numbers we can’t picture, numbers that normal human consciousness cannot comprehend. And when we add the imaginary numbers to the real numbers, we have the complex number system. The first number system in which it’s possible to explain satisfactorily the crystal formation of ice. It’s like a vast, open landscape. The horizons. That is Greenland, and that’s what I can’t be without!*

There is a silent pause and now what does the typical male do in such a situation? He is confronted with a beautiful woman bearing her soul, exposing her innermost feelings to him. What is he to do? ‘Smilla,’ he says, ‘Can I kiss you?’ An alternative, suggested by another Victorian was to say ‘Ok, Smilla, your number is up!’

**Conclusion**

Cognitively well nourished students are a result of a rich and varied diet of mathematical pedagogical and content knowledge. Recipes that are unhealthy should be removed. Using too much salt is just as unhealthy as using cognitive emptying/elicitation/exposition recipes in the classroom. Teachers must resist becoming mere packet warmers by some educational administrators and systems. They must combat and challenge:

… the ever-increasing impact politics has upon what happens in schools and individual classrooms. At worst, the result is to reduce the teacher’s role to that of technician, turning flair and creativity into teaching-to-the-test mode. I believe we have to find ways of educating those who are likely to have little idea of the dynamics of life in the classrooms or about what teaching entails. We must find ways of informing political and civil servants of the complexity of imposing structures and ‘standards’ in education in ways that fail to recognize that classrooms are emotional places; learning cannot be reduced to a series of levels or grades monitored by outside agencies (Ollerton, 2003, p. 4).

So I conclude upon a hopeful note. This MAV conference fills me with hope. It is evident in the desire and passion of most of the classroom chefs present at this conference. And it is through their collective power via the Mathematical Association of Victoria that I feel the profession will demand more that the politically expedient ‘microwave warming’ solutions that are on offer.

It would be remiss of me if I didn’t include a final very old food connection to teaching workloads. Surely there is at least one reader that is young enough not have heard the old saying that while ‘bread may be the staff of life, the life of the staff is no loaf’.

**References**


**AAMT STANDARDS: 1.3, 3.2**

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