MATHEMATICS EDUCATION FOR THE KNOWLEDGE - BASED SOCIETY

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1. What am I offering in this address?

It is a great honour for me to give the opening address to this conference and of course I am very happy to be here again in Khon Kaen, Thailand. I am also happy with the topic which I have been given by the organisers, and my talk today will offer the following five contexts for you, which I will briefly clarify now:

- A frame for the conference discussions?

This conference is focussed on teacher education in mathematics and particularly on the use of 'lesson study' as a means for developing both the theory and the practice of mathematics teacher education. But it is necessary to keep this topic framed, particularly in such a short conference as this is, in order that we maximise our time together.

- A context for considering generalisations?

Mathematicians and mathematics educators love generalising – it is valued as one of the basic means for developing mathematical ideas. The challenge for us however is that where mathematics seeks to develop ever more abstract ideas, teacher education must always strike a balance between abstract theory and concrete practice.
Both student teachers and experienced teachers will reject any ideas for teacher education that do not strike what they feel is the right balance between the two objectives.

- An explicitation of some hidden assumptions?

In my research on values in mathematics education, it is clear that most values teaching and learning takes place implicitly in the mathematics classroom. This is also likely to be the case in the context of this project, which is even more problematic since we come from very different cultural and social contexts. It is vital that in our discussions we keep aware of the hidden assumptions and values which are not necessarily shared by all.

- A personal view on the values involved in this project?

Having mentioned values above, it is necessary for me also to clarify my values and assumptions within this conference topic. No researcher is value-free!

- An opening up of some of the issues involved?

Although my topic is not especially about lesson study, nevertheless I feel it is necessary for me to at least expose my ideas about some of the issues involved in this development. (I must also ensure of course that you do not go to sleep!)

2. Definition of knowledge-based society

My topic is certainly an interesting one, full of issues of definition, values, goals and predictions. But in 2003 there took place the World Science Forum in Budapest, Hungary, and their theme for that conference was Knowledge and Society (see website ref.) In it they gave a useful definition of a Knowledge-based society, and here are the main points:

- A knowledge-based society is an innovative and life-long learning society
- It possesses a community of scholars, researchers, technicians, and firms engaged in research and in production of high-technology goods and service provision
- It forms a national innovation-production system, which is integrated into international networks of knowledge production, diffusion, utilization, and protection.
- Its communication and information technological tools make vast amounts of human knowledge easily accessible.
- Knowledge is used to empower and enrich people culturally and materially, and to build a sustainable society.
- Innovative
- Life-long learning
- National and international networks of learning communities
- ICT goods and service provision
- Empowerment/enrichment of society culturally and materially
- A sustainable society

In some ways this is a formidable list, containing both descriptive and prescriptive ideas. Every country would have something to aspire to from this list and all of us attending this conference here today would have reservations about whether our countries are achieving any of these goal descriptions. But it is good to have such a challenging list to begin our deliberations here.

3. How to consider education in this new context?

In particular it is a challenge to consider education within this new context. But is a knowledge-based society really a new idea? We should ask ourselves what is different now. Society has always used and taught knowledge, but originally it was the family context which provided the education, from whom the knowledge came and with the elders being the 'teachers'. Gradually as education became more formalised, the schools developed from the families. Also the content of what was taught became more

organised, and became based on the knowledge supplied from the 'academy'. Finally the teachers became officially recognised, needing official qualifications and eventually being specifically trained.

Now as the knowledge society is developing, we find that the new knowledge comes from 'outside' the accepted sources, from the Web, from the media, from peer-group networks and also from wide international sources. But many questions also arise for us in education: Whose knowledge is it? Who is producing it? Whose personal knowledge is being exploited and whose personal knowledge is being ignored? Basically the question now facing us is: What is the source of the authority of any new knowledge?

4. Kinds of education => Kinds of mathematics education

Coombs(1985) gave a very helpful analysis in his book 'The world crisis in education.' He based his analysis on three kinds of education: formal, non-formal and informal. According to Coombs, there are crucial distinctions to be made between these, and I feel that we too need to be aware of these within our special field. Thus I offer you three kinds of mathematics education whose distinctions are I think crucial in considering our roles in a knowledge-based society. The three sets of characteristics are based on Coombs.

Formal mathematics education is the formal system most of us are part of, and it consists basically of the state system which exists in most countries. It is largely the only kind which gets recognised in research in our field, and operates up to student ages of around 16 or 18 years. It is

- Structured
- Compulsory
- A coordinated system, which is
- Staffed by recognised teachers

Non-Formal mathematics education is the kind of non-compulsory and optional education offered by courses such as for adult education, or vocational education and training. For formal school-age students, it could be after school classes, cram-school classes etc. Generally it is:

- Structured
- Non-compulsory/optional
- With a specific focus
- Coordinated to a certain extent, and
- Some teachers are recognised, some not.

Informal mathematics education is the largely unstructured and often accidental education which comes from a variety of sources, and 'happens' to all of us. Whether it is

on the Web, on TV, via computer programs, in the papers, or journals, or occurring at conferences like this one. Its characteristics are that it is:

- Unstructured
- Accidental
- Uncoordinated, and with largely
- Unrecognised 'teachers'

Coombs particular contribution for me was that we have to consider the last category as a form of education, to look at it through educational eyes. It makes us think about questions like Who are the 'teachers'? What is their agenda? What is the nature of the mathematics being taught? How do these ideas intersect with those being taught in the Formal system?

5. Where is development happening?

If we continue with these three categories, we can ask some more interesting questions, such as where is development happening in mathematics education? Regarding the three categories, we can summarise things this way:

Formal Mathematics Education (FME):

- Developing slowly in terms of mathematical knowledge
- Developing slowly in terms of pedagogy
- Difficult to change the system
- Difficult to change the examinations
- Student input to changes limited

Non-Formal Mathematics Education (NFME):

- More responsive to knowledge changes
- Pedagogical developments less restricted
- More scope for individual teachers to develop courses and materials
- Less controlled by examinations
- More responsive to student inputs as 'clients'.

In-Formal Mathematics Education (IFME):

- Responsive to, and often initiating, knowledge changes
- Opportunistic with respect to 'pedagogical' changes, no examinations
- No formal teachers means greater experimentation and innovation
- Client-led learning
- Lack of control on authority for knowledge

6. Responses of Mathematics Education to the growth of the knowledge-based society

Now we can begin to identify how mathematics education is responding to the growth of the new knowledge based society. For example we can see that IFME is highly responsive, and is often leading the developments. Via the Web, new computer programs, and international networks, we are seeing many developments (or pressures for developments) taking place.

NFME is responding in some ways, in particular in changing the structured courses to respond to client needs in the training and vocational education sectors. In fact as the business models for the NFME providers become much more sophisticated, and in line with other businesses, this sector of mathematics education is exerting much influence on the formal sector. In some ways the borders between IFME and NFME are becoming rather blurred.
On the other hand, and in stark contrast, the FME sector is slow to respond, and even then with minimal changes. There are some changes in curriculum taking place, particularly with the pressures from those who are advocating more emphasis on Numeracy, but there have been few changes in pedagogy, even though ICT is becoming more prevalent in schools and classrooms.

7. What particular developments should we aim for in FME to prepare our students for the Knowledge-based society?

Firstly any Formal Mathematics Education must balance several complementarities:

- Individual growth v. class/group/grade development
- Traditional content v. expanded knowledge
- Traditional pedagogy v. ICT and student-led pedagogical approaches
- Formal systemic examinations v. individual assessment

So bearing these balances in mind, let us explore the definitions of, and criteria for, a knowledge-based society and see how we would develop our FME in our different countries:

Innovative society

- Teaching should encourage more creativity in the students
- Individuals' and groups' original ideas should be valued by teachers
- Assignments should allow creative initiatives
- Assessments should reward creative ideas and solutions to mathematical problems

Life-long learning

- Laying the skill foundations for problem-solving and creativity
- Teaching information searching

- Teaching information validating
- Developing publication and knowledge-sharing skills

National and international networks of learning communities

- Encouraging knowledge networking
- Demonstrating learning community activities
- Contributing to, and using information from, those communities

ICT goods and service provision

- Increasing the familiarity of teachers and students with ICT equipment and software
- Recognising the limitations of ICT as information and communications media

Empowerment/enrichment of society culturally and materially

- Recognising the cultural and historical nature of mathematics knowledge
- Recognising how mathematics assists, informs, and thereby 'formats' society
- Recognising the limitations of mathematical knowledge

A sustainable society

- Mathematics education should embrace environmental education
- Values education should be more explicit
- Balancing individual goals and societal goals should be addressed

8. Final thoughts

Lesson study needs recognising as a socially situated research practice

This is where the Social dimension of mathematics education needs greater recognition (Bishop, 1991). It operates at these five main levels:

Cultural level - language, values, culture, history
Societal level – politics of society, educational institutions,
Institutional level – within institutional rules and goals, internal politics
Pedagogical level – within the classroom, teacher and students as social group
Individual level – individual students' and teachers' backgrounds and goals

Any lesson study research is therefore situated within any particular cultural, societal, and institutional context.

The cultures and values of researchers need recognising

Related to the points above, we should note that no research is ever value free, there are always goals, assumptions, histories and institutional politics at work. Moreover, we researchers are never value free either! We have our own goals, histories and values, and these will inevitably affect what and how we prefer to research.

International sharing, networking and awareness need encouraging

At an international conference such as this, and despite the fact that many people here are working on the same lines, there will inevitably be similarities and differences between us. This should not be considered as a problem but welcomed. We all develop our ideas by experiencing contrasts, and thus we should be celebrating and valuing diversity and enjoying the challenging contrasts such a conference provides. In the same way we should all of us beware of cultural/linguistic imposition. Regrettably I am guilty of imposing my language on you all, and I therefore finish by apologising for that. Nevertheless I hope that you will forgive me, and also that you try to see through the barriers of languages to consider the ideas which I have presented to you.

I hope you all have an enjoyable and stimulating conference.

References

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World Science Forum 2003:
http://www.sciforum.hu/index.php?content=wsf2003&image=wsf2003