International Journal of Advanced Research in Engineering Technology & Science
ISSN: 2349-2819
Email: editor@ijarets.org Volume-3, Issue-3 March- 2016 www.ijarets.org

MAKING MATHEMATICAL LITERACY A REALITY IN CLASSROOMS

Dr. S.K.Sharma
Research Supervisor
Deptt. of Mathematics
C.M.J.University
Rai Bhoi, Jorbatt
Meghalaya

Deepak Kumar Salar Passed
Research Scholar
Deptt. of Mathematics
C.M.J. University
Rai Bhoi, Jorbatt
Meghalaya

BACKGROUND

The story so far in a recent paper we reviewed the history of the teaching of modelling in school mathematics curricula, focusing on developments in the UK and the US. The early explorations in the 1960s were followed by twenty years of more systematic development, so that by about 1990 there were proof-of concept courses and course components of various kinds across the age range 10-21. These demonstrated that typical teachers can teach modelling skills if they have well engineered teaching materials and some, relatively modest, professional development support. Students in these courses demonstrate a power over practical problems, from real-life or **'fantasy'** worlds, in which their mathematical toolkits play an important role in the analysis and reporting. They handle, for non-routine problems of appropriate complexity, the various phases of modelling shown in the diagram, and not only the solve phase on which school mathematics is normally focused.

The importance of these clear qualitative gains have kept the focus of work so far on development rather than insight-focussed research in depth, on the engineering rather than the science of the teaching and learning of modelling. There have been a few studies in greater depth with some interesting results, such as Vern Treilibs detailed study of formulation processes. Among other things, it documented the **'few year gap'** between the mathematics students can do in imitative exercises and those that they choose and use when modelling. These examples underline the need and opportunities for research to provide further insights into the processes of modelling, how students learn the skills involved, and how teachers can help them. Some studies will focus on design research that can help the field move practice forward, rather than simply academic studies.

In summary, we know how to teach modelling, have shown how to develop the support necessary to enable typical teachers to handle it, and it is happening in many classrooms around the world. The bad news? **'Many'** is compared with one; the proportion of classrooms where modelling happens is close to zero.

Why is this, and how can the situation be transformed so that modelling is a feature of the mathematics curriculum for every student- the prerequisite for mathematical literacy? What we mean by mathematical literacy, its importance as a life skill, and its role in making mathematics itself meaningful and useful to most people.

BARRIERS THAT OBSTRUCT THE LARGE

Scale implementation of modelling and, indeed, other curriculum improvements, linking these to various levers that promise progress. From a societal perspective, the school mathematics curriculum is worse than regrettable; it is scandalous. Currently most people in their adult lives use none of the mathematics they are first taught after age 11. Further, study after study has shown that school mathematics gives them none of the aesthetic satisfactions that people get from, say, music or literature. Modelling is the missing ingredient.

WHAT IS MATHEMATICAL LITERACY?

Many different terms are used in various places and circumstances: mathematical literacy is the most widespread, quantitative literacy is favoured in the U.S. functional mathematics is now fashionable in the U.K. while numeracy was originally defined as the mathematical equivalent of literacy. Distinctions between these terms are not widely agreed; for our purposes, they are unimportant. PISA defines (ML) Mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen.

BARRIERS TO LARGE-SCALE IMPROVEMENT

Some of the key implementation challenges we face. These are discussed in more detail in and Burkhardt (2006).

- **System inertia**-

The limited large-scale implementation of modelling is not unique; it has proved difficult in many countries to establish any profound innovation in the mainstream mathematics curriculum. This should not surprise us. Teaching modelling requires changes in the well-grooved practices of teachers, their teaching skills, and their beliefs about the nature of mathematics-and those of parents and politicians. To become part of the mainstream curriculum, it is not enough to be **'good'** and **'important'**.

- **The Real World-**

The real world is an unwelcome complication in many mathematics classrooms. The **'purity'** of the subject is something that attracts people to teach mathematics; for them, using mathematics to tackle real world problems is not their job.

- **Limited Professional Development**-

In many countries teachers are expected to deliver a curriculum on the basis of the skills they acquired in their pre-service education, consolidated in early years in the classroom. In a changing world, continuing professional development is essential but in most countries is not yet an integral part of most teachers' week-by-week work.

- **The Role And Nature of Research And Development**-

The role and nature of research and development in education, as compared with other applied fields, is not well organised for turning research into practice. Burkhardt and Schoenfeld looked at how this process can be improved, learning from research-based improvement in medicine, engineering and other fields. The growing role of **'design research'** in education is a move in this direction but more is needed if policy makers with problems are to turn to the research community to solve them. The research and development agenda that these barriers imply is huge and work on it is at an early stage. They are all worth working on.

THE IMPORTANCE OF COMMUNICATION

The story of modelling in school mathematics is one of mutual incomprehension between leaders in mathematical education and those they seek to serve. The public and most politicians see mathematics as '**What I learned at school'**. The mathematical limitations of many students, which they regularly deplore, are seen as a failure to make every child mathematically **'like them'**. The changes in the mathematical skills that society needs are acknowledged, but their implications are not understood. This needs greatly improved communication.

Contributions to the media are the first area that needs attention.

- These need to explain and illustrate the changes. The mathematics curriculum is still focused on developing reliable technical skills in well-practised procedures; everywhere except in schools, these are now performed by technology. In this more technical world, where computers do the routine things that clerks used to do, people need a broader range of higher level skills so as to be flexible problem solvers who can handle change.
- This is not an easy communication challenge- people don't want to read about mathematics, so media are reluctant to publish such pieces. Skilled writers of ‚popular science' can provide help.
- Assessment tasks can be useful tools- they communicate new goals in a vivid and compact form, bringing to life verbal explanations; otherwise these are interpreted within each reader's experience.

THE ROLES OF ASSESSMENT

In trying to reform curriculum, assessment is often an afterthought-important for evaluating progress and, perhaps, for holding schools to account but not a core part of planning and development. This attitude leads to a tragically missed opportunity. Why? There are two key reasons, one already noted:

• Assessment tasks provide a clear and vivid statement of the learning and performance goals of the change. Teachers, students, politicians and the public can understand them. In contrast, lesson materials are too bulky to be easy to comprehend- or for policy makers to read- while 'standards' alone, focussing on separate ingredients of mathematics, do not specify performance.

• In systems with strong **'accountability'** pressures on schools, most teachers teach to the tests. Many people deplore this but the tests, whatever their limitations are the main target that society sets for successful learning. Thus the tests effectively define the implemented curriculum. **'Authority'** is often reluctant to accept this, perhaps because it implies a responsibility for designing high-stakes assessment that reflects all the performance goals of the curriculum in a balanced way - this costs more.

MODELS FOR SYSTEMIC CHANGE

These components of successful change will only be effective if integrated. Piecemeal changes of the right kind have often been tried: new textbooks, but with the same tests; more professional development, but on an occasional basis; changes in policy involving new 'standards'; and so on. Such attempts have proved inadequate, so that mathematics classrooms today are much like those our grandparents were taught in. What are key characteristics of a model that is likely to prove effective? Experience in other domains suggests-

- **Coherence Policy**, curriculum specification, classroom materials, assessment and professional development support all need to be closely aligned, developed together, and clearly communicated.
- **Sensible pace of change** Politicians, and many in education, like **'Big Bang'** solutions that will **'fix the problem'** once and for all. However, there is much to be said for gradual change. It gives the many groups, particularly teachers, who have to absorb profound changes time to absorb them. It also offers year by-year gains that reconcile the few-year timescale of elections that drives politicians with the decade timescale of significant improvement in education. This model has proved effective. The Shell Centre (1984-86) worked with a leading English examination board to introduce specific profound changes to the mathematics examination at age 16, providing assessment, curriculum and professional development materials. These units were popular with teachers.
- **Realistic costing** in government initiatives the challenges are usually underestimated and the money provided for development is grossly inadequate. This guarantees failure. It is better to scale down or spread out the goals so that realistic costing can be reconciled with spending limits.

Success is never, of course, guaranteed but this kind of sensible planning avoids guaranteed failure. The need for further research and development is clear; the above analysis is a contribution to specifying such a program.

SCENARIOS FOR THE FUTURE: OPTIMISTIC AND OTHERWISE

History should make us cautious. The most likely scenario is little or no change. Most of those involved will be happy to avoid extra challenges in their already busy lives. However, there are some things that allow us to be more optimistic.

PISA is now the prime international comparison between countries' performance in mathematics, and it is designed to assess mathematical literacy. Politicians care about the results. Some countries are making policy moves to bring modelling into mathematics. Following the high-level Tomlinson (2004) and Smith (2004) enquiries, the British Government has made **'Functional Mathematics'** a central goal for English schools. Time will tell whether the government will make the moves needed to make functional mathematics a reality (Shell Centre 2005).

The problem of establishing modelling as a regular part of school mathematics remains work in progress- but progress there is.

REFERENCES

1. Burkhardt, H., & Schoenfeld, A.H. (2003) 'Improving Educational Research: toward a more useful, more influential and better funded enterprise.' Educational Researcher, 32, 3-14
2. Smith Report. (2004) 'Making Mathematics Count.' London: Department for Education and Skills, HMSO. Retrieved Nov. 13, 2005
3. Treilibs, V., Burkhardt, H. (1980) 'Formulation processes in mathematical modelling.' Nottingham: Shell Centre Publications.
4. Swan, M. (2005) 'Improving Learning in Mathematics.' Sheffield: Department for Education and Skills.