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Secondary mathematics teaching: Should it be all chalk and talk?

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Anjum Halai describes how methods of teaching mathematics are being reconsidered in Pakistan.

SECONDARY MATHEMATICS TEACHING: SHOULD IT BE ALL CHALK AND TALK?

Secondary school mathematics! Does it always have to be taught through 'chalk and talk'? My experience as a learner and later as a teacher in schools in the context of Pakistan was that mathematics in the secondary school was mostly taught through traditional methods using lectures and blackboard work. But does it have to be so ? In a recent experience of planning and implementing an eight-week course for teacher education I tried to find the answer to this question.

I taught mathematics to secondary school children for eight years before being seconded for a two-year Masters degree (M.Ed.) course in teacher education from a prestigious local university. This course is part of a new programme initiated by the university. It offers a field-based education to its students who would then go on to work jointly for a period of three years with the university and the school which initially sponsored them to help educate fellow teachers in contemporary teaching methodologies as well as enhance their subject knowledge. Most graduates spent the academic year half in school and half in the university. In university, it was required that they would plan, implement and evaluate eight-week teacher education programmes for teachers from a range of schools and geographical locations. These programmes were offered in mathematics, science, social studies, English and primary education.

Working together makes learning easier and meaningful

In this article I look at my experience of working with some colleagues and faculty on the eight-week mathematics programme. We tried to present secondary mathematics through a variety of teaching strategies like co-operative learning, discussion-based teaching and practical work, along with the traditional lecture method.

So, what looked like Jane Fonda's workout session was in fact teachers getting a feel for the half, full and quarter turns in angle formation by using body movements. Are there angles more than 360 degrees? You could see adults turning round and round in the bright sunshine. Should they say one turn and twenty degrees? Is it not the same as 380 degrees? Known and familiar content was suddenly problematic. Teachers who had hitherto treated angles as the union of two non collinear rays were forced to acknowledge that introducing angles through body movements made them broaden their earlier static vision of an angle to include a more dynamic one.

The idea of using investigative teaching approaches in trigonometry, a topic which is usually regarded as difficult and unimaginative, was appreciated by all participants. Suddenly, trigonometry became more approachable and closer to life. Enthusiastic participants observed their instructor moving around a circle to denote a point P, while two others moved up and down the axes to give a feel for the projection on the x axis (cos θ) and on y axis, (sin θ) when the point on the circle moved. Making a simple instrument and using it with their

How high is the building? Participants using their knowledge of trigonometry to find out.

knowledge of trigonometric ratios to find the height of a nearby building also helped bring the knowledge of higher mathematics closer to life.

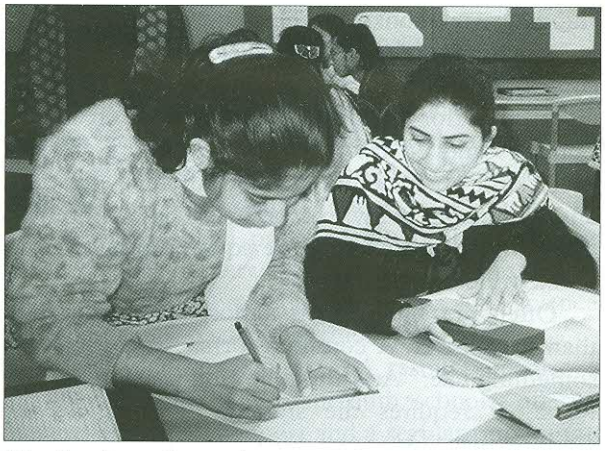
Of course, formulae were not accepted as given in our classroom. In fact, pattern seeking and generalization were hot favourites with teachers who had never before experienced the beauty of seeing and expressing a structure. Teachers, who had accepted rules like $a^2 - b^2 = (a+b)(a-b)$ as given were seen approaching them through specializing numerically and generalizing the pattern observed. Others used geometrical representations to make sense of it. Concrete material, which is usually considered too frivolous for secondary classes, was very much in evidence here. Some were seen using the colourful Multilink cubes to aid their thinking.

With problem-solving strategies it was the process and not the product which was the focus of the activity. Of course, constructing a shampoo container to hold 200 ml. of shampoo was not regarded as a waste of time by those who now realized the richness of the activity in providing an opportunity to apply mathematical knowledge. Did it not provide an opportunity to assess pupil understanding of volume and capacity? What about the processes of problem-solving and mathematical thinking? Don't the practical tasks provide better opportunities to assess pupils' thinking and problem-solving abilities? These and other such questions became the topics of discussion among teachers who were keen to think of the implications of the new ideas for their own practice.

Traditionally, stress on written algorithms and drill are regarded as characteristics of good mathematics teaching. As a result, talk, discussion and co-operative learning are all strategies which, even if used effectively in other subjects, are considered alien to the mathematics classroom. During our sessions we made a deliberate effort to structure activities which generated mathematical talk. Now you could hear a buzz of conversation going on in the seminar room. The topic could be as varied and diverse as 'why does minus multiplied by minus yield plus?' or 'what is the most succinct way of expressing a pattern seen in a situation?

Assessment of the programme by the participants and the course leaders revealed that, among other things, using a variety of teaching strategies was really effective in promoting conceptual learning. Hence, my initial question was answered. Secondary school mathematics does not have to be through chalk and talk. But introducing a variety of teaching approaches in the mathematics classroom did raise a number of other questions for me:

- What does the new classroom mean to the teacher who values 'silence' as 'discipline' and 'written algorithms' as 'evidence of learning'?
- What is the teacher's role in the new set-up?
- Which new skills or attitudes (if any) will the teacher have to learn before he or she feels comfortable in setting up a variety of learning situations to maximize individual pupil potential?



Two heads are better then one.

- Are the new teaching methodologies compatible with high achievement in examinations?
- Is written examination the most appropriate way to assess learning? If not, what are the alternatives ?

I believe that these and other such questions would have to be considered seriously by teacher educators and teachers before the mathematics classroom changes from a silent room with pupils struggling over algorithms to produce right answers to a classroom characterized by a healthy discussion about mathematical ideas leading to a deeper understanding of the principles underlying routine procedures.

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