TEACHING OF MATHEMATICS: WAY FORWARD

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INTRODUCTION

Many studies show that students perceive school mathematics as lacking relevance and consider it abstract, theoretical, dull and authoritarian (Sidhu, 1988; Kumar, 1993; Bashir, 2000;). The curriculum is often overcrowded with unfamiliar concepts leaving little room for enjoyment, curiosity and a search for meaning. Learning mathematics generally requires hard work and considerable intellectual efforts, which are not a dominant part of contemporary student's culture (Shami, 1999). Among the different subjects of school curriculum mathematics is graded as difficult and "hard core" subject. It is also being criticized for lacking relevance with every day life and social and cultural contexts as well as having little reference of contemporary issues. Students are generally afraid of studying mathematics due to various reasons; 'method' is being one of them. They tend to learn mathematics through a mechanical process rather than a meaningful approach (Kumar, 1993).

Use of Activity based approach to enhance Maths education

Educationists has emphasized that mathematics is a subject, which has to be learnt by doing rather than by teaching. The doing of mathematics gives a rise to the need of a suitable method and suitable place. Teaching through activities (Laboratory method) preferably in a proper environment (mathematics laboratory) is the only answer to it. It is widely recognized that mathematics is a science, and as there are activities in science it is imperative to treat mathematics on the same lines. During teaching learning process the need for special environment is obvious to make mathematics understandable to the learners with the help of activities and material.

Activity based approach emphasizes practical development and application of concepts rather than theoretical. However, it is also recognized that some theoretical understanding is necessary, which obviously requires balance between theory and practical activities. This approach when applied in mathematics facilitates students to learn the concepts. On the other hand, it also supports the concept of preparing the students for life long learning. This approach, however, also demands, interventions to make activity oriented mathematics textbooks.

This paper describes the results of a research study focusing quality improvement in mathematics education and promotion with the use of mathematics laboratory. The primary purpose was to assess the perception of teachers regarding the teaching method through activities and the subsequent need for the mathematics laboratory in schools. This experience has been advocated by the authors to modify the teaching style in mathematics teaching and to identify equipment and materials for mathematics laboratories to provide a more effective teaching learning environment through the Science Education Project-II in Pakistan.

Mathematics enjoys an important status in the school curriculum and is compulsory subject from grade 1 to grade 10. However comparing the outcome at various levels, expose the teaching of mathematics in Pakistan. National pass percentage at secondary level is 63% in mathematics, 83% in Biology, 76% in Chemistry and 84% in Physics (SSC Examinations (annual) 2005). It appears that performance of students in Biology, Chemistry and Physics is comparatively much higher than their performance in mathematics. At primary level national average score is 48% in mathematics and 65% in science. At this level, the performance of children in science is satisfactory whereas the performance in mathematics is quite low (Khan & Shah, 2002). The previous studies undertaken in Pakistan (Shah, 1984; Rugh

et al. 1991; Khan et al., 2000) also indicate the same pattern of performance in mathematics and science.

AEPAM study (Khan et al., 2000) on learning achievement at primary level further highlights that the performance of boys is comparatively better than the girls in mathematics whereas the girls perform better in science than boys. It has also been observed in mathematics over the years that there is a consistent increase in the percentage scores of the students but it has not been attributed to the method of teaching instead it has been correlated with the parental education.

The study of AEPAM (2005) in comparative performance of students by school management (Shami & Hussain, 2005) reveals the state of arts education in our schools. The focus was to assess the learning achievements of grade four students and thereupon quality of education was compared among the schools. The achievements of

Grade	Public			Private			Total		
	Mean	SD	%	Mean	SD	%	Mean	SD	%
A1: Excellent	84	4	7	85	5	6	85	4	6
A: V. Good	74	2	6	74	2	11	74	2	8
B: Good	64	3	17	64	3	22	64	3	18
C: Satisfactory	52	3	16	51	3	23	52	3	19
D: Poor	40	3	20	40	3	19	40	3	20
F: Fail	22	9	35	23	9	19	23	9	30
National	45	21	100	51	19	100	47	20	100

(Source: Shami & Hussain, 2005)

Table 1: Performance of Students in Mathematics by school management

the students were graded as A1, A, B, C and D whereas students scoring below 33% were considered as fail.

The study reveals that mean percentage score in mathematics at national level was 47 (47% questions correctly answered). On the average one of the five students performed very well. Dishearteningly the performance of half of the students was graded as "poor" or "fail". The analysis of the national situation indicates that most of the students lack the basic competencies and skills in mathematics.

National Assessment Report 2006 revealed that grade 4 students achieved a national scaled mean score of 421 (total score = 1000) in the mathematics test. The students performed well in knowledge based items such as simple computation, questions about place value and estimation of length, capacity and weight. At the understanding level, students achieved average results on items of computation, estimation of length and weight while students performed least well in the application tasks of fractions, odd and even numbers, problem solving, measurement of line segment, information handling and line graph. The reason for performing low in these above mentioned concepts is the lack of practical activity, because the concepts in fractions, odd and even numbers, problem solving, measurement of line segment, information handling and line graph etc are needed to be taught concretely instead of teaching them abstractly & theoretically.

The method of teaching mathematics is traditional, predominantly expository or lectures. Even though everybody recognizes that lecturing for entire class is one of the least effective teaching methods, when numerous exercises are presented as examples lecturing does produce same effects through rote learning. In this method students remain passive and teacher dominates the teaching learning process. The effective teaching demands active participation of students during the teaching learning process where the participation is of different forms. The educational literature is evident about the value of active learning in the classroom instead of passive learning through lectures.

Most of the teachers in the study were bachelor's degree holders, professionally well qualified having experience of teaching mathematics. They had heavy teaching load in terms of the number of periods per week, as well as over burdened due to other subjects they were teaching. But a large number of schools have manageable class size. Majority of the teachers had not attended any in-service training course in mathematics. Almost all the schools were well equipped with facilities like science laboratory, play ground and library, which were considered quite essential for school education. However mathematics is a subject which occupies core position in school curriculum. However the practical activities were

completely absent in the country wide curriculum at primary, secondary and higher secondary stages. Consequently the prescribed textbooks lack practical activities. It appears that the practical activities are neither valued in the curriculum nor being conducted by the teachers in schools. Obviously, most of the schools lack the equipment and material necessary to conduct the practical activities in mathematics.

In this study, teacher's opinion and feed back on the activity based practical components of existing mathematics curriculum was solicited. From the responses received, a majority of the teachers (74%) indicate that existing contents of their mathematics course is deficient of practical activities, However 20% considered some where in between and only 6% felt it as appropriate. 78% teachers responded that they were teaching mathematics as a theoretical subject due to the pressure to cover a lengthy syllabus in overcrowded classes. Most of the teachers (70%) neither access to the equipment nor to the material for conducting practical activities in the schools. 84% of the teachers even expressed their limitation of teaching mathematics through practical activities; where as only 16% were feeling comfortable with the evolving opportunity of teaching mathematics through laboratory activities.

S#	CONCEPTS	EQUIPMENT	RESPONSES Approval (%)
1	Place value, numeration, addition & subtraction	Abacus	80
2	Classification, logic, sets & subsets	Attribute blocks	90
3	Equation, inequality operations, commutative, associative & distributive properties	Beam balance	74
4	Length, area, volume, capacity, metric measures, fractions, number patterns & geometric relationships	Centimeter cubes	76
5	Counting, sorting, place value, basic operations, geometry & measurements	Color cubes	76
6	Operations with whole numbers & place value	Chip trading material	58
7	Counting, place value & arithmetic operations	Counting sticks	78
8	Inequalities, fractions, proportions, sets & numeration	Cuisenaire rods	60
9	Fractions, equivalent fractions, addition, subtraction, multiplication & division of fractions	Fraction board	70
10	Surface area, volume, 2-3 dimensional spaces, projectors, scaling & mapping	Geo-blocks	66
11	Number concepts and patterns, Cartesian coordinates, shapes, area, angles, symmetry & fractions	Geo-boards	62
12	Mass measurement & volumes	Pan balance	56
13	Symmetry, congruence, similarity, area & angles	Parquetry blocks	74
14	Relationship between diameter & circumference, measurement of circumference	Trundle wheel	76

Table 2: Responses of teachers regarding identified mathematical concepts and their teaching appropriateness through Laboratory activities

Some concepts were selected and related equipment and materials were identified for finding out the perception of teachers and its appropriateness in teaching maths through laboratory activities. Selected activities were demonstrated with the help of identified equipment and material (Table 2). In response to the appropriateness as well as relevance between selected concepts and related equipment, almost all teachers (98%) agree but the degree varies.

Demonstration reflects that nine sets of equipment were properly conceived by teachers in relation to respective concepts. Five sets of equipments and respective usage for teaching the respective concepts were conceived partially. The two equipments i.e. Chip Trading Material & Pan Balance could not be comprehended properly by teachers. This might be due to their lack of awareness & grasp on the content. It appears that the math teachers lack proper awareness of relevant concepts & their development. However, it is interesting that almost all the teachers do recognize the relationship of equipment with concepts & hence their fitness for teaching mathematics through laboratory.

After exposure teachers did recognize that understanding of concepts could be developed through practical activities with the help of special equipment and material. The teachers training program were expressed as not effective. This could be the main reason that most of the teachers were unable to perform and teach mathematics through practical activities.

The study indicates that majority of the teachers did not feel comfortable in conducting practical activities and thus teach mathematics purely as a theoretical subject. It is revealed that teachers have very little knowledge about

the concepts, which could be taught through practical activities. They also lacked the awareness of specified equipment & material. Though they were familiar with some equipment in mathematics, they had a limited knowledge of related concepts which could be taught through practical activities.

Majority of the teachers desired for the establishment of mathematics laboratory in all schools so that practical activities could be organized and conducted. Changes were demanded by the majority of the teachers in the syllabus and textbooks of mathematics, teaching methods, examination system and teacher training in order to popularize practical activities in math teaching. In order to prepare appropriately, teaching load of math teachers required to be reduced. Practical activities need to be included in the syllabus and textbooks of mathematics, at all the levels of education.

It is encouraging that the Govt. of Pakistan being alive to the needs has attempted to reform mathematic education in the country. Mathematic kit is being produced and teachers guide on math kit has been prepared. The idea of math resource room for teachers is also in the pipeline. Specialized institutions like NISTE and provincial institutes of teacher education (PITEs) therefore need to review their programs for training of mathematics teachers to focus on the teaching of mathematics through the use of devices, equipment, material and apparatus. Practical exam in mathematics can be a facilitating factor. Special guidebooks on usage of equipment, practical material and apparatus can assist teachers. At initial stages refresher courses on regular basis can set the scene. Most importantly due interventions are required in teacher education pre-service programs such as C.T, PTC, B. Ed and B. S. Ed. for introducing practical components of mathematics teaching.

Conclusion

The study leads to the conclusion that learning environment must be both knowledge-centered and learner-centered to the future of education in the 21st century. Rigorous and resolute thoughts are being accompanied by warning not to ignore education particularly mathematics. The advocated trend of teaching math through laboratory activities will continue to gain acceptance and even become more pronounced into clear orientation and reality. The study has attempted to indicate promising development in the teaching of mathematics that throw light on the lines to be followed.

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