

MATHEMATICS AS SEEN BY PUPILS AND TEACHERS: A WAY FORWARD

Indira Chacko

Africa University, Zimbabwe, indira@syscom.co.zw

Information gathered through informal and formal methods portrayed mathematics as a subject not favoured by many. In addition, data gathered by direct observation of lessons at the primary school level, revealed mathematics lessons being dominated by routine tasks, which eventually lead to boredom and frustration. This project is an attempt to get the teachers to make learners active participants in the learning process by changing the observed role of the teacher from that of leader to more of observer and guide.

This project materialised due to a number of concerns and the major among these are the attitude of non-specialist teachers and secondary school pupils to mathematics as well as the performance of secondary school pupils in the subject and the need for positive changes in both of the above.

i. Views of pupils and non-specialist teachers about mathematics

Using questionnaires, views of pupils at both primary and secondary school levels and non-mathematics teachers for primary and secondary levels undergoing in-service training, to school subjects was gathered. One hundred and fifteen primary school pupils in Grades 5,6 and 7; 128 secondary school pupils in the Ordinary level class and thirty in-service teachers completed the questionnaires.

In the case of pupils, respondents indicated three subjects each they like and dislike most and the reasons for their attitude. Teachers were asked to list a maximum of three subjects each they liked and disliked when they were pupils at elementary and secondary school levels and the reasons for their views. In addition, they were asked to identify a subject each they enjoy and find difficult teaching.

Ninety-three out of 115 (81%) of primary school pupils identified mathematics as one of the subjects they like. Their most frequent reasons were that it is easy to 'work out' or do and a pass in the subject provides better job opportunity. In the case of the secondary school pupils, 89 out of 128 (69.5 %) listed it as one of the subjects they dislike and their reasons include poor teaching, negative attitude of teachers to pupils and lack of materials like textbooks. Twenty-one out of 30 (70 %) said that they liked mathematics at the primary school level but at the secondary school level most of them found it difficult. Poor teaching stand out as the reason for this. Twenty-four out of 30 (80%) teachers indicated mathematics as one of the subjects they find difficult to teach, which agrees with their difficulty in learning it at the secondary school level. Their reasons for this include lack of content mastery and materials.

There seems to be an agreement between the views of the teachers and that of the secondary school pupils where teachers find it difficult to teach and pupils think that the teaching is of poor quality. When secondary school pupils were asked to suggest ways to improve teaching and learning of the subjects they disliked, majority suggested to replace existing teachers with qualified teachers and provide the pupils with necessary materials like textbooks.

It is a well-known fact that in this country, admission to tertiary institutions as well as selection for most jobs is based on a good pass in mathematics, yet at secondary school level, they seem to be drifting away from the subject. Attitudes are not innate but developed over a period of time and attitudes do affect achievement and vice a versa. From the past to now, researchers have established the relationship between attitude and achievement (Husen, 1970; Mogari, 1999) where positive attitude is found to encourage learning and higher achievement. Peer influence, teaching approach,

attitude to the teacher, success in the subject, parental support, perception of the utility value of the subject are some of the factors that influence attitude to a school subject. Among these, teaching, as it has a direct and immediate effect on attitude and achievement, which the secondary pupils complained about, need to be studied, to correct any short comings, with the hope that this may change the attitude to mathematics and achievement in the subject.

Is there any more supporting evidence to the attitude expressed by secondary school pupils?

Poor performance in public examinations in mathematics at Ordinary level, is something that indirectly supports the negative views expressed by the pupils of that level.

ii. An overview of the results in Ordinary level mathematics for the period 1991-1998

Table 1

O Level pass rate in Mathematics (non- calculator) for 1991-1998

Year	1991	1992	1993	1994	1995	1996	1997	1998
% Pass	24.8	23.8	25.3	24.4	21.4	18.9	18.5	17

For the period 1991 to 1998, pass rate in public examination in mathematics, at Ordinary level, ranges between 17 and 25%. At the same time, as mentioned earlier on, Mathematics and English are prerequisites for admission to most tertiary institutions as well as for most jobs available in the market. If this is so, what makes the pupils fail so badly? Why do they have a negative attitude to mathematics?

This makes it necessary to obtain first hand information about teaching. Primary school level being the first stage of formal education, it was decided to start at this level and if necessary, move on to the secondary level.

iii. Procedure

In order to obtain the pattern of teaching at the primary school level, a sample of teachers, from Grades four to seven, in one school were observed while teaching mathematics and these lessons were coded using a pre-validated low inference observation system. The main focus of the observation system is the teacher hence the choice. This system, among other things, gathers information about the context of the lesson, that is the group or the individual being addressed by the teacher; the nature of interactions between the teacher and the pupils as well as among pupils; and the stage of the lesson as introduction, expansion, consolidation, review and evaluation.

a. Validity and Reliability of the observation instrument

Over the years, the instrument had been used in various researches by the author and had been modified, to suit the needs of large classrooms in developing countries. On various occasions, whenever modifications were introduced, inter or intra observer reliability was computed using Pearson r, which ranged between 0.72 and 0.85, which is of acceptable level.

b. Data collection, analysis and results

All the teachers teaching grades 4,5,6 and 7 in a school, closer to the author's institution, were selected for lesson observation. At a meeting with the teachers concerned, the purpose of observation and the procedure involved was discussed. This occasion was also used to develop rapport with the teachers, which is essential in gathering data through direct observation. Class schedules of the teachers was collected and they were informed that the lessons had to be observed

without pre-warning, only to ensure that the lessons are not specially prepared for observation. Within a period of six to eight weeks, each teacher was observed thrice.

Almost all the lessons observed were on review. From past experience of observing lessons, it is found that the presence of an outsider in the class, in most cases, make teachers panic. This makes most of them carry out review possibly with the notion that review is mostly seat work where they need not go through much of teaching.

Table 2
Percentage frequency of interactions under “who to whom” category

Categories	Percentage frequencies/grades →										
	7A	7B	6A	6B	6C	4A	4B	Mean	Median	Max	Min
TG	60	38	50	38	38	54	50	47	50	60	38
TS	4	35	14	35	10	9	11	17	11	35	4
GT	23	7	18	7	34	11	18	17	18	34	7
ST	11	19	18	19	18	24	21	19	19	24	11
SS	0	0	0	0	0	0	0	0	0	0	0
TO	1	1	0	0	0	1	0	1	0	1	0

Key: TG: teacher to whole class, TS - Teacher to individual student, GT: Whole class to teacher

ST: Individual student to teacher, SS: student to student, TO: Teacher to other

Who to whom: Who initiates the interaction and to whom it is directed

By sorting the interactions under the 'who to whom' category, the lessons observed had more of teacher initiated interactions where on the average, 47% of the interactions were directed to the whole class and 17% to individual students. It is pertinent to add that the percentages observed here is comparatively lower than those observed in two other developing countries that are comparable in terms of class size and availability of materials to Zimbabwe, which is worth mentioning. This could also be due to the fact that the observation covered only one school, which produces good results in the public examinations and probably has more qualified and experienced teachers.

Among student initiated interactions, those from the group or whole class to the teacher had 17% while from individual student to the teacher had 19% of the total interactions. The interactions that originated from the pupils were in answer to teacher's questions. There were no voluntary contributions or suggestions or request for clarifications from the pupils. Although the instrument is teacher focused, due to the suggestions received at an earlier conference, student to student interactions was incorporated into the instrument but no such interactions were observed. The pupils were sitting on tables in groups of four, five or six and whenever a problem was given, they shared books but not ideas.

By looking at what was going on in the class, lecture (16%), recall questions (12%), response to questions (18%), seat work (15%), and procedure (13%) top the list of interactions. Questions were picked from the textbooks and the answers did not need thinking and organising, therefore there was no challenge to the learner. In case a pupil was unable to answer a question, often it was redirected to another thereby giving no encouragement to the pupil concerned. Probe, cues, high level or thinking questions, relating content to real life situation where ever this was applicable, use of actual or improvised teaching materials in explaining concepts were rarely seen in these classes.

Sequence analysis revealed the most common sequence as teacher question or directive to the whole class or individual followed by response or silence. If there was silence from the class or individual then, the teacher usually redirected the question to someone else or answered the question. A directive in this particular instrument is an order from the teacher like solve this problem, open the book and the like which the student is expected to comply.

c. Why do pupils play a very passive role in the learning process?

The class is a miniature community where the norms are more or less that of the larger one. When the teachers on in-service training were asked about the role expected of the child in the society, the responses were contribute without criticism (32%), accept everything from adults (27%), children should be seen and not heard (27%) and others (14%). At the same time, when the same teachers were asked about the role of the pupils in the class, the responses were, 'criticise where necessary' (56%), 'contribute without criticism' (27%) and 'accept everything from the teacher' (17%). The responses to the two items do not seem to agree much but the response to the item about the roles expected of the child in the society and that of the classroom behaviour of the pupils seem to agree very much, where the pupils play only passive roles.

d. What is the perception of the pupils about the use of various topics in mathematics?

In order to determine whether the topics in mathematics are taught in context, Grade 7 pupils were asked to give the uses of some of the topics they have studied in mathematics. The responses that were common on selected topics follow.

Table 3
Perceived uses of topics in mathematics by pupils

Topic	Use
Large numbers	To read, write, add and subtract; to know; use in big companies and banks; many responses were "don't know"
Percentages	To find out how much out of 100; use in profit, loss and discount; to find answer
Average	To add and divide; to share equally; not to get a mark below average

It appears that in the classes observed, learning in context is missing. In most cases, as the children correctly said in the questionnaires, 'mathematics is easy to work out' or it is rather procedural, which makes it easy at the primary school level but at the next level, when they are required to think and handle problems, it becomes difficult. Responses of in-service teachers do support the notion that mathematics was easy at the primary school level but became difficult at the secondary school level. Added to this, is probably the teaching approach, which the secondary school pupils complained about, that makes mathematics more difficult for the learners. As secondary school pupils reported, often teachers who lack content mastery become dictators thereby chasing learners away from the subject.

iv. The need for in service training using video taping of lessons

Sample teachers as well as most of the teachers on in-service training confirmed that they never had the opportunity to view their lessons. All through their training, they were instructed about teaching and then they went through practice where they were given feed back about teaching. Whenever one is given feedback about teaching, it is coming from a second person, which is not the same as viewing the lesson. In the other countries, where video taping and viewing was tried by

the author, most teachers could not believe what they saw, which in itself helped to change their teaching for the better. In that set up, many of them were also grateful for providing the opportunity to view their lessons. The teachers that were observed in this case seem to be eager to improve their teaching and it is hoped that by providing the opportunity, the teaching and learning of mathematics will only stand to gain. As Chanakira (1998) puts it, in Zimbabwe, teacher interacts with the pupils, parents, the community and the state and it is envisaged that the training to be more democratic in the teaching-learning situation will flow from the teacher to the pupils and to the larger community.

v. Theoretical background and the objective of training

Ages ago, based on research results and common knowledge, educationists and others (Anderson, 1939; Amidon & Flanders, 1961; Amidon & Hough, 1967; Brophy & Good, 1974) tried to encourage the classroom climate that is more democratic where learner freedom is increased and more positive attitude to learning is developed which in turn encourages higher achievement. This project is based on the same theory that democratic climate is more conducive for learning and teachers should be trained along this line.

The major objective of the training here is to change the current teacher-pupil role from leader-subordinate where the teacher eventually becomes an observer and guide thereby changing the pattern of learning by listening to that by doing. In a nutshell, the training is to change the classroom climate to be more democratic where there will be more freedom for the pupils to be actively involved in the learning process and to be responsible for their learning. This means a drastic change from the societal norms yet it is only to develop the potential of the children, which is for the progress of the community and not for its retardation hence should be well received by all.

vi. The procedure for training

Before training, teachers will not be given any feed back from the lessons observed. This is to give them the opportunity, to be more objective while giving self-critique of the videotaped lessons. The first step is to videotape at least three lessons of each of the sample teachers, spread over four weeks. This will be played back for self and peer evaluation. At this stage, the teachers will be given the opportunity, to indicate the aspects of teacher behaviours that give more freedom to the learners to take active role in learning and encourage critical thinking and problem solving abilities in pupils and those that they should improve upon. Past experience has proved that often, teachers consider student responses to recall questions as active participation, which is an area of controversy. Usually, this opens up discussions about active and passive participation and the benefit of active participation by pupils as opposed to passive roles they usually play like answering teachers questions verbally or in written form. From the discussions, the need for pupils to be responsible for learning and decisions about teacher behaviour to get pupils to be active learners will be arrived at. Other behaviours that are needed for reinforcement and encouragement like probe, acknowledgement and cues, which were not observed in the lessons, will also be discussed and incorporated in the training package. Use of problem solving approaches, group work, learning by discovery, which were missing in the sample lessons observed, will also form part of the training.

During training, the researcher will provide lessons of good and poor quality, on topics selected by the teachers, to the four different grades, where emphasis will be on the theme of the training. The teachers will observe and criticise these lessons and suggest ways of improving.

Next stage is the presentation of a lesson each by each of the teachers to their classes, which will be video taped and viewed and criticised by all, followed by actual teaching in their classes and video taping without pre-warning and viewing by the teacher and the researcher. Pre and post training lessons will be compared by each of the teachers and the researcher, to identify improvement in the various areas included in the training package, especially in the involvement of pupils in the learning process which is expected to provide the incentive to progress further. The instrument for evaluating the teachers is yet to be developed.

The school system here uses performance appraisal, where the head of school appraises the teachers. The researcher is of the view that later in the school year, some feedback about the performance of the sample teachers, pre and post training, could be obtained from the head of the school for scrutiny by the author.

Based on the success of the training, the procedure could be adopted first in the author's institution, for further trial, modification and recommendation for adoption by other teacher training institutions.

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