Are Teachers Out of Step with What Their Mathematics Learners Value? An Analysis of Views Held by Learners and Educators on Cooperative Group work.

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Cooperative group work is an advocated approach of teaching and learning in the new South African Outcomes Based Curriculum (OBE-Curriculum 2005). The approach is one of the critical outcomes prescribed by the curriculum. Cooperative group work is also implicitly encouraged by the curriculum's definition of mathematics. Clearly, much of the promises held by the new curriculum will come through cooperative group work! Invariably, mathematics educators need to identify and utilise the advantages of cooperative group work in improving their practices. This is particularly true for the disadvantaged educators who have been condemned to mediocre practices in mathematics as a result of the intentions of apartheid teacher education. The paper discusses the findings from the study, which was conducted in two black township schools. Thirty learners and eight teachers participated. The aim of the study was to investigate the views of the educators and learners on cooperative group work. The study found that the views on cooperative group work held by learners indicated that they regarded this approach as having a positive influence on their understanding mathematics. However, the views of educators indicated that they are unaware that their learners learn better through this approach.

INTRODUCTION

The political changes have created a need to reconstruct and develop mathematics education for all in South Africa. The poor performance of the country's standard five and six mathematics learners in TIMSS, only serve to reinforce the need for reconstruction. Hence, in the past few years there has been mushrooming of initiatives which seek to fix the problem in accordance with the Afix INSET culture espoused by Dawson (1998). Invariably, almost all these initiatives conveniently choose to ignore the documented complexity of factors that brought along prevalent poor performance in mathematics teaching and learning for the majorities in the country. For any practitioner who was subjected to the atrocities of an inferior education from her first day in school, such omission seem to be a ploy to defeat the intended purpose of improvement.

As part of introduction, the background of mathematics teacher training which prepared teachers for decades will be briefly discussed. In doing so, the past and present societal expectations of teachers will serve to contextualise the study. Mathematics education has been underpinned by Verwoed's vision, the architect for apartheid.

> *I will reform the Natives education so that they will be taught from childhood to realize that equality with Europeans is not for them* ***. People who believe in equality are not desirable teachers for Natives*** *. What is the use of teaching the Bantu child* ***mathematics*** *when it cannot use it in life? That is absurd. (Hirson, 1979, p.45)*

Black colleges of education, earlier known as teacher training colleges, were established to train native teachers in accordance with Verwoed's vision. They had an inferior and separate curriculum from their counterparts who belonged to other races. Implementation was closely monitored through common examinations developed by the senior educational authorities.

Mathematics teacher educators in these colleges were mainly white Afrikaners who in most cases were not adequately qualified to teach mathematics in their own schools. Black academic staff taught vernacular only and the majority were unskilled labourers. Hence, mathematics teacher educators had little understanding of black schools, the lives of teachers and their plight. They had little concern and/or ability to improve mathematics teaching practice as this would undermine the rules and the system of the day.

When political changes took place in the early nineties, more blacks were introduced as academic staff in colleges. The curriculum and examinations remained under the control of the central government. After the democratic government was elected into power, new policies in education were developed. One of these was the policy on teacher education .The first draft was published in 1995 and

had been in the process of revision year after year. It promulgated a paradigm shift in teacher education for all. However, Mkize (1998) revealed that not much change was observable on the ground, that is, mathematics classrooms in college, where change was most needed .

The findings from the commissioned National Audit on Teacher Education (1995) confirmed the known. The quality of mathematics education in the majority of colleges was such that their graduate teachers were under-prepared to teach mathematics effectively. Hence, the regular high rate of failure for black matriculants in mathematics.

Outcomes Based Education has been introduced as a national curriculum 2005 for schools. In its launch in February 1997, the then minister of education and training, Dr Bhengu stated, "The curriculum aims to equip all learners with knowledge, competencies and orientation needed for success after they leave school. Equipping learners to take specific roles in the society has always been the goal of education." Verwoed's vision also wanted to equip learners to take up specific roles. As a result of the new curriculum, mathematics teacher educators and practising teachers have to make a paradigm shift from what they had been doing all their lives in accordance with the training they received!

Much criticism has been levelled against the new curriculum, only two of these will suffice for this paper. Jansen (1997) has cited ten convincing reasons why OBE will fail in South Africa. For example, the complexity of the language associated with the curriculum, the lack of fiscal base and political will to provide intervention that will ensure successful implementation. Mano (1995) contends that over and above lack of widespread hard evidence that transformational OBE works; its implementation is very costly.

Despite such criticisms which are alerting policy makers and practitioners on the difficulties around OBE, this study was motivated by its positive aspect, namely its advocated approach of learning, the cooperative group work. The latter formulates part of one of the critical outcomes in OBE-Curriculum 2005: "learners will work effectively with others as members of a team, group, organisation and community". Cooperative group work is further elaborated implicitly in the curriculum's definition of mathematics:

> *Mathematics is the **construction of knowledge** that deals with qualitative and quantitative relationships of space and time. It is a **human activity** that deals with patterns, **problem-solving, logical thinking**, etc. in an attempt to understand the world and make use of that **understanding**. This understanding is expressed, developed and contested through language, symbols and social interaction*(NDOE, 1997).

Social interaction provided by group work provides an ideal opportunity for expression and debate by learners.

JUSTIFICATION OF THE STUDY AND ITS VALUE

Therefore, this pilot study sought to investigate the views of teachers and learners on cooperative group work, thus establish the feasibility of implementation of this approach in mathematics teaching that would make the positive impact in mathematics teaching and learning that has been documented by research. Findings are discussed against the background of teacher training these teachers went through. Such a discussion aims to inform appropriate teacher development initiatives that purport to equip teachers to successfully implement the new curriculum and prepare the teacher of the 21st Century.

THEORETICAL FRAMEWORK

Reconstruction and Development in mathematics education.

In the past critical thought, independent thinking and questioning were discouraged in the school system. In reconstructing the past, one of the education and training's principles is:

> *The curriculum, teaching methods and textbooks at all levels and in all programmes of*

education and training, should encourage critical thought and independent thinking, the capacity to question, enquire, reason, weigh evidence and form judgements, achieve understanding, recognise the provisional and incomplete nature of most human knowledge.(White Paper on Education and Training, 1995, p21).

Artzt (1990) claims that cooperative group work has been credited with the promotion of critical thinking, higher-level thinking, and improved problem solving abilities of students. Bringing in higher-order thinking and reasoning to a lesson and ensuring individual learning are also cited among elements that define cooperative group work by Lazier (1991). Moreover, Vygotsky (1978) contends that social relations among people underlie all higher cognitive functions and their relations. Cooperative group work capitalises on social relations as a basis for learning.

Cooperative group work and achievement in mathematics

Reviews on cooperative group work in mathematics by Davidson (1985,1989), and by Webb (1985,1989) have shown positive effects in other areas as well as in academic achievement. Davidson (1989) reviewed more than 70 studies in mathematics comparing achievement in cooperative learning versus whole class traditional instruction. In more than forty percent of these studies, students in the small groups significantly outscored the control students on the individual mathematical performance measures. Cobb, Wood, Yackel, Nicholls, Wheatley, Trigatti & Perlwit (1991) and Wood & Sellers (1993) found that children in classrooms which encourage collaborative interaction to solve challenging problems, learn mathematics with greater understanding than do children in traditional classes. Since achievement and understanding are closely linked, greater understanding is likely to lead to increase in achievement.

Cooperative group work in mathematics education reforms in other countries

Reforms in mathematics education in other countries have incorporated cooperative learning as one of the recommended approaches for teaching. For example, in the United States of America and Netherlands.

In the United States of America, the role of cooperative groups in developing mathematical processes is justified by the country's document on mathematics education reform:

*Small groups provide a forum for asking questions, discussing ideas, making mistakes, learning to listen to others' ideas, offering constructive criticism, and summarising discoveries in writing. Presentation of individual or group reports provide an environment in which students can practise and refine their growing ability to communicate mathematical thought, processes and strategy (*Curriculum and Evaluation Standards for School Mathematics ,1989).

Terwel (1990) reported that cooperative learning have been an integral aspect of the innovation in mathematics education in the Netherlands . He contends that cooperative learning is like a rich gold mine. However, Terwel admitted that **it took twenty years of researching** and developing strategies of implementing cooperative group work to the level where significant improvement in achievement in mathematics could be observed.

Cooperative group work and social theories.

Mathematics classrooms in the past were either communities that promoted quality learning and achievement in mathematics or communities that created a culture that deterred learners from pursuing mathematics. However, according to the new constitution, all have a right to quality education, this includes quality mathematics education. Therefore, all classrooms need to be turned into communities of quality learning of mathematics.

Aspects of social practice theory by Lave and Wagner (1991) have much to offer in the reconstruction of mathematics classrooms as communities of quality learning where the teacher as a master, models what it means to be a member of the mathematics community. In support of this view,

Lerman (1999) objects to the use of understanding to describe students and suggests that students should be described in accordance with their progress in the process of forming identities within the practices of one of their mathematics learning communities, i.e.,classrooms. Such a view has implications for professional development for practising mathematics teachers. Professional development needs to enable teachers to be masters who can guide their learners as they become experts in mathematical practices.

With no particular reference to social practice theory, Schoenfeld (1987) found that cooperative groups engage in behaviour that is similar to those exhibited by expert mathematicians when they solve problems. They begin to monitor their own thoughts, the thoughts of their teammates and the status of the problem. In other words cooperative Group work creates the enabling communities of becoming experts where the teacher's role as a master becomes crucial. For one thing, the teacher must be a full member of the mathematics community, particularly outside the classroom, otherwise, it would be a case of a blind leading the blind.

DESCRIPTION OF THE STUDY.

The pilot study had a baseline and an intervention phase for grade eleven students. Thirty learners and eight teachers from two marginalised schools participated in the baseline phase. Only seventeen learners and one teacher volunteered to participate in the intervention phase. The number was reduced because the intervention took place after school hours. Different questionnaires were administered to teachers and learners to investigate the views of the educators and learners on cooperative group work. See appendix 1. Classroom observations of lessons conducted in a cooperative mode served to confirm the teachers' responses on the questionnaires. The intervention served to confirm the learners' views.

The intervention was a series of linear programming lessons in a cooperative group work mode. Since most regular textbooks were designed for a whole class approach, lessons in a cooperative group work mode were developed and conducted by the researcher; the teacher was an observer. This approach is in line with Ivey's (1986) view of uncovering the richness from understanding the researched from inside with him\her. At the end of the intervention, learners were given open ended questionnaires to describe the impact of the intervention.

RESULTS

Classroom observations.

Two lessons in a cooperative group work mode were observed in two different classes. In one class, the teacher divided the class into smaller groups and conducted an inductive lesson in a whole class approach. She wanted learners to find for themselves that the angle in a semi-circle is a right angle . Unfortunately, only three sets of mathematical instruments were available for the class of thirty students. In another, the class the teacher had prepared worksheets on circle geometry riders. Apparently, theorems on circle geometry had been learned the previous week; therefore this was a consolidation of what has been learned.

Teachers' responses to the questionnaire

What was of interest was that eight teachers had almost similar responses on six questions in the questionnaire. It must also be noted that all graduated from the same college of education, situated in the area where they are teaching. See the appendix for the questionnaires. Responses on each are discussed below and compared with the observations.

Item 1. Responses indicated **familiarity and some theoretical understanding** of cooperative Group work. The most common response was "students work in groups on their own and teacher only helps when required." However, classroom observation revealed the limited use of cooperative group work.

Item 2.All respondents claimed that preparing for a cooperative group work lesson is not the same as

preparing for a lesson in a whole class approach.
However, classroom observations revealed that the difference between preparing a cooperative lesson and whole class lesson was simply dividing a set of problems to smaller groups rather than to the whole class or teaching a class which is seated in smaller groups.
Item 3.**They perceive supervision as the most important role** they have to play during group work, for example, they stated that "cooperative group work requires constant supervision" and "the teacher must supervise group work". **None seemed to be aware of the role** they need to play in *facilitating* learning rather than transmitting knowledge. Indeed teachers did supervise the cooperative groups and made sure they were available to attend problems experienced by groups.
Item 4. What the teachers value in cooperative group work is that it helps slow-learners to get a chance to understand mathematics that was not understood during the normal lesson. It seems as if cooperative group work is of no value to those who understand the teachers' lesson.
Item 5. **Teachers do not think that cooperative group work can improve mathematics achievement for their students.** If cooperative group work helps those who did not understand in class, it may well be even those who understood do not necessarily achieve in mathematics, therefore having more learners who understand the lesson does not improve achievement in mathematics.
Item 6.The greatest disadvantage for cooperative group work is it takes up too much time and teachers are rushed to complete the syllabus and **therefore there is no time for cooperative Group work in class.** This was confirmed by classroom observations that indicated that learners were unfamiliar with this approach in a formal setting. Indeed, one teacher was particularly uncomfortable.

Learners' responses

There were seven items designed to elicit the views held by learners on cooperative group work in mathematics learning. **Item 1** purposed to find out whether learners had experienced a lesson in a cooperative group work mode. Thirty five learners had never been exposed to group work in their maths classes, hence they did not continue to fill in the questionnaire. Thirty continued filling in the questionnaire. Responses from those who had been exposed to group work are given in (Table 1, p 8) in the order of their popularity.

INTERVENTION

Learners were asked to name their groups and each group developed its rules. Teachers would not have done a better job in setting up these rules, moreover, learners owned them and therefore that gave them a sense of loyalty to them. The rules included the following: no parasites, give others a chance to talk, outside information is allowed, no one is wrong or right, teamwork, and respect other members' opinion. After the intervention, learners described the impact of the intervention as responses to three open ended questions, namely, describe the level of participation for other members of the group participate? What went well? What could be better? Table 2 summarised the responses.

DISCUSSION

The study revealed a discrepancy between what is valued by learners and teachers. Teachers only value cooperative group work for giving "slow learners" a chance to understand. If this is the case, cooperative group work should ensure that all learners understand. However, this does not seem to be valuable enough for teachers to invest more time on this approach of teaching. In fact, its greatest disadvantage is that "it takes too much time". On the other hand learners seem to view cooperative group work as an approach that enhances their understanding in mathematics regardless of their cognitive abilities. This is testified by the learners' comments: "Discussion improved my understanding of mathematics" and "At last we gained something from a maths lesson". The understanding learners are talking about is their *personal understanding* reached as a result of their discussions and debate with their peers on the mathematical content they had to deal with. It is not the understanding that Lerman objects to. That type that teachers use to label those who can regurgitate what they have said during a

lecture. In fact, most learners claimed that maths is easier when they learn in cooperate groups because it is difficult to understand teachers.

Learners view cooperative group work as having potential to increase their achievement in mathematics; "If this project had started earlier we could have had better results in mathematics at the end of the year." and "everyone would pass mathematics with flying colours, if we can continue to learn mathematics like this." These comments are contrary to the teachers' view that "cooperative group work cannot increase achievement in mathematics for their students."

These findings imply that teachers seem to lack the knowledge of the approaches that enhances their students' learning. Moreover, it does not seem that teachers are aware that cooperative learning is a powerful approach that has been extensively used in reforming mathematics education, internationally. For example, Cobb *et al* found that cooperative learning enhances learning mathematics with greater understanding. However, this is in line with the type of three years training they went through, as a means to equip them to teach. The National Audit on Teacher Education , page 74, found that not only do college student teachers go through the curriculum with a sharp **divide between theories and practice**, but one that is out of step with the **current intemational advances in knowledge and methodologies**.

Limitation on the use of cooperative learning was demonstrated during classroom observations. If it is used, cooperative group work is mainly for consolidating what has been learned. It is no wonder that they see cooperative group work as taking up too much time, of what could be done as homework. It is therefore conclusive that learners, mostly engaged in cooperative groups either outside the classroom setting or without the teachers' assistance. This is evidenced by for example, "Working in groups would make us pass mathematics, the school must help us to work in groups" and "we must work in groups in our class".

Mathematics teachers for black schools were trained to occupy specific roles under the old system of education. The impact of the conflicting views and ingrained beliefs about mathematics teaching and learning between the old and the new systems of education, on teachers cannot be over estimated. This involves both disadvantaged and advantaged. On the other hand learners, pupils are still generally open to how they feel about issues; their fate on what is possible and not possible is not yet sealed. In view of this, teachers cannot be labelled as being out of touch with what their learners value. The findings of this study within the country's context simply indicates that there is a breakdown of communication between mathematics teachers and learners; regarding the purpose of their togetherness. Change has never been popular as being an easy process. Kawaka, Stigler and Hiebert (1999) assert that changing the way a teacher teaches is notoriously difficult. The political miracle in the country is not equivalent to an educational miracle.

CONCLUSION

Mathematics teaching and learning for the 21st century has to change from what it has been in the 20th century, an exclusive activity. This statement alone has exacerbated problems instead of solving them. Because many researchers in mathematics education believe they were immune to the system that legalised and did everything possible to keep the majorities out of mathematics. The legacy left by the mathematics education of the 20th century has unfortunately become a golden opportunity for the advantaged to pursue whatever is closed to their hearts through development and research programs. Clarification of this by Mahomaholo and Matobako (1999) revealed the existence of two competing paradigms, whilst one is geared to empowerment, the other unconsciously seeks to maintain the status quo. Suggested empowerment research paradigms by Mahlomaholo *et al* should be taken seriously.

Much as the study pointed out on the weaknesses of the past, it revealed the existence of hope among

the most important party of all our efforts, the learners. It is therefore suggested that the learners must be at the centre of those initiatives that are meant to develop teachers. Teachers will have no other way but to change when they observe their learners changing.

Finally, OBE may have its difficulties, however this need not deter the mathematics community from exploring its positive aspects such as cooperative learning, which has potential to take mathematics teaching and learning to the highest heights in the 21st century.

APPENDIX: TEACHERS' QUESTIONNAIRE

1.Write anything else you would like to say about your understanding of cooperative group work.
2.Is preparing for a lesson in a cooperative group work mode similar to preparing for a lesson in a whole class approach. Briefly give an explanation for your answer.
3. What are the important roles ,if any, which are different from the whole class teaching approach?
4. What do you value in cooperative group work?
5. Does cooperative group work increase achievement in mathematics for your students.
6. What are the disadvantages of cooperative Group work?

STUDENTS' QUESTIONNAIRE

1. Does your class sometimes work in smaller groups during a maths ?
2. Explain to a friend what your class does when they work in smaller groups during a maths lesson.
3. What makes you happy when your class is divided into groups for a maths lesson?
4. What do you hate when your class is divided into groups for a maths lesson?
5. Is maths easier when you and your classmates explain things to one another in a group than when the teacher alone does the explaining?
6. Is maths more fun if your class is working in smaller groups? Yes/No
Give reasons for your answer.

Item 2 **Defining group work to a friend**. Helping each other when we do not understand When the teacher is not in class we discuss When we discuss and practice mathematics. We work in groups and a representative of each group then explain to the rest of the class what the group has been doing. The teacher gives a topic and we all contribute ideas on the topic. The teacher takes the pupil who understands maths better and let him explain to others in the class. The whole class participate in a lesson	**Item 5 Is maths easier when you learn in cooperate groups.** Students come up with different methods that are easier to understand I am free to ask anything It is difficult to understand teachers We do not have to listen to the teacher all the time we only go to them if we do not understand Some teachers become angry when you keep on asking questions We have a chance of showing that we understand maths We do better in tests Only one respondent said, "No because only the teacher knows the theorems"
Item 4 What they hate about groupwork Groupwork where some member(s) do not contribute because of selfishness or laziness. Ridiculing others when they make mistakes When groupwork creates disorder and too much noise When you do not have any ideas and yet you are called upon to present on the chalk board or, to be a group leader When you ask a member of the group and they refer you to the teacher AWorking with girls	**Item 7 On whether they learn new things during groupwork** You can not rely on the teachers information We learn to speak out We learn to know each other We learn to help one another Some of our peers have new ideas about maths I understand what I would not have understood from a teacher
	Item 6 Is maths fun when cooperative groupwork is used during a maths class Yes because We understand maths We share ideas and methods We help each other We participate in the class ,

	We have a chance to express ourselves We have a chance to do maths on our own In a group we are more relaxed and the goal is to understand If you explain something to your classmates you know you never forget it.

Table 1

What went well: I enjoyed the lesson , We understood most of the things we did very well, Everyone came with an idea, At last we gained something from a maths lesson , We enjoyed the lessons≅ , AEveryone was thinking, We learned about **linear functions and graphs ,** When we work as a group things become easy , We always found a possible and a correct answer , Discussion improved my understanding of mathematics, We now understand **linear graphs,** I understand things I would not have understood if the teacher taught me, Mathematics became very good≅, ASharing the task makes things easier, We all learned≅, We **understood linear functions and their graphs** Most of the things we did we understood
What could have been made better If we can keep on working like this in mathematics classes, we could pass. If we continue helping each other and sharing our problems Working together and encourage one another we will pass. We must continue this groupwork. Working in groups would make us pass mathematics, the school must help us to work in groups. Understanding more by working together. Things will be better in our lives if we had started earlier in the year. If this project had started earlier we could have had better results in mathematics at the end of the year. We must work in groups in our class. Everyone would pass mathematics with flying colours, if we can continue to work learn mathematics like this. What could be better is that this mathematics programme must go next year. The programme must be done by other classes

Table 2

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