

Role of Teachers in Implementing Cooperative Learning in Mathematics Classes: Some Considerations from Existing Literature

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Abstract

This paper identifies some benefits of cooperative learning methods that can be best implemented in mathematics class to increase numeracy skills in students. Existing literature on cooperative learning was examined to provide a conceptual noted on cooperative learning. Cooperative learning has a number of significant effects on mathematics achievement and attitudes towards mathematics.

Introduction

According to the 2000 Education Commission Report, schools in Fiji are encouraged to provide for effective education in mathematics to increase numeracy skills in students. It is evident that achievement of students is strongly linked to high quality teachers. Consequently the question that arises is: what makes a high quality teacher? In this context, the question would be: what makes a high quality teacher of mathematics? In order to improve student achievements in mathematics, and to raise standard of numeracy skills in Fiji, it is crucial that primary schools introduce effective teaching methods.

In Fiji, competencies of students in mathematics continue to be an issue of major concern. The Ministry has revealed that at the 7th form level, only 18% of students achieved a pass (50 %+) in mathematics external exams, but these figures were elevated through scaling (MOE, 2014). This paper examines the cooperative learning method with a view towards culling out some key features of this method which may make it easier for policy makers to assess its suitability for Fijian classrooms.

Background to Cooperative Learning

In order to succeed in today's challenging world learners require '21st century skills'. To develop this skill in mathematics classroom teachers need to face the challenge to start shifting from a 20th to 21st century classroom. One of the ways teachers could overcome this challenge is to move away from traditional chalk and board (or jug and mug) method of teaching to more student centered learning. According to Johnson, Johnson & Holubec (1992) in the current era of education, students are encouraged to discover and build their own knowledge through active participation. In this globalized world emphasis is placed on learning mathematics by problem solving rather than memorizing of facts and figures. In other words teaching mathematics with understanding is encouraged rather than memorizing rules and algorithms to solve problems (NCTM, 2000).

Tasker (1990) has suggested incorporating cooperative learning into primary school classroom as a way to bring changes in teaching methods for effective learning. Johnson et. al (1992), also support that the primary means of achieving the new paradigm of teaching is to use cooperative learning. Cooperative learning was introduced to teachers in United States in 1960 (Slavin, 1995).

Johnson and Johnson (2004) propose that the main aims of cooperative learning are to improve motivation, encourage positive attitudes, and better social skills. Johnson and Johnson's earlier study (1989) supported the finding that cooperative experiences promote higher self-esteem than competitive and individualistic experiences. Slavin (1995) found that students who learn cooperatively tend to be more highly motivated to learn.

In cooperative learning small group of students work together, communicate their ideas and solve problems given to them (Artzt and Newman, 1999). In a cooperative learning environment, the role of teachers in the classroom changes. The way in which the learning material is presented to the students and the way in which teachers communicate with students during group work, influences students learning interaction.

Research has shown that cooperative learning has positive influence on student's involvement in math's related materials (Ferreira, 2001). Students appear to enjoy working cooperatively and are willing to cooperate with others in the group (Knol, Janson, Neerman, Vander, Linder, 2004). Though cooperative learning is used widely in mathematics classroom, a growing need exists to examine the role of teachers in this process. In particular, there is a need to examine how teachers use this technique in a mathematics classroom setting.

Mathematics Education in Fiji

In Fiji poor performance in mathematics at the primary school level has been and still is a subject of much debate among policy makers, teachers, parents, educational experts and other stakeholders. As recognised by the 2000 Education Commission poor achievement in mathematics at the primary level is a significant barrier, which continues through secondary school and to further education and/or employment. In order to improve standards of mathematics in primary schools, it is crucial that teachers introduce effective methods for student learning. The Education Commission Report (2000) showed that teacher trainees learn best practice pedagogy during their pre-service training, but once they are posted to the classroom, they often revert to rote and dictatorial styles of teaching.

High performance in examinations, especially external exams (Fiji Year 6 exam, Fiji Year 8 exam and LANA for Years 5 and 7), is given high priority by the Ministry. For these, the exam papers are prepared by the Ministry of Education; they also, of course, prepare the syllabus. For teachers and stakeholders, exam results are of great significance. Due to exam oriented system teachers get concerned with finishing the syllabus and drilling students with exam questions and answers. In some schools Saturday classes are conducted by teachers to train and prepare students towards exams. Because of such exam testing system, teachers get reluctant and sometimes hesitant, in using other approaches to teaching and learning of mathematics. Some of these alternatives would take up much time; they are generally deemed irrelevant to passing exams.

The traditional method - the chalk and talk method - is still being practiced in almost all schools. Children are given rules, definitions and examples on the board by the teacher which is later used by the students to follow and solve given mathematics tasks. In such types of teaching students are forced to memorize facts and formulas. As a result, learning in mathematics gets divorced from real life situations; learning with understanding does not take place. Consequently, the classroom does not get lively; they remain without social interaction. The outcome is students losing interest in learning mathematics. In turn poor result in mathematics continues. According to Nairn, Harish, Tiko & Treacy (nd) an analysis of Fiji Islands Literacy and Numeracy assessment test items in one of their studies showed that students were experiencing difficulty in all areas of mathematics number, measurement, space and statistics.

Recent Reforms in Fiji

According to Toch (2010) the neoliberal ideology involved the concepts of competition, choice, and privatization which over the years have spilled into public education. Levin & Belfield (2003) and Toch (2010) state that public education slowly adjusts to new methods and terminology such as accountability, assessment, site based management, evaluation products and global competition. Due to globalization and Fiji government's continuing reliance on aid from other countries, particularly in the development of its education system, the education system also slowly moves towards neoliberalism. Lots of reforms have taken place all over the world in relation to improving quality of education and use of teaching methods to deliver to the best where no child is left out. Neoliberalism is not static in any country.

In a neoliberal education system, public school management/board, as well as privately run schools, gain greater power and authority to manage their affairs. As a result they could impose conditions which could adversely affect children from lower income families. In addition due to globalization and evolution of knowledge based economy, additional pressures are created for nation states to improve and maintain their competitiveness in the global economic environment.

Recent policy announcements show that primary education (from classes 1 to 8) is now compulsory. Government has started providing assistance to encourage parents and students to keep to the policy on compulsory education. Assistance provided includes free text books, bus fare allowances, and free milk and cereals for first year primary students. Such forms of assistance are common in a number of countries. In the US, for example, the *No Child Left Behind* policy was a very clear move to ensure that all students (including the homeless, migrants, special education need students and students from all social classes and ethnic backgrounds) must gain yearly progress and achievement in English language and mathematics in grades three, five and eight (US department of Education, 2012).

In Fiji various reforms have taken place since 2000. The curriculum, teaching methods, and mode of assessment have been reviewed in order to produce education outcomes which would improve our competitiveness in the global marketplace. In 2011 external exams in Primary schools were abolished and schools were encouraged to conduct internal assessment as the form of identifying a child's ability. In 2014 exams were brought back in. Government started providing support to schools by substantially raising financial grants to schools. Pressure on teachers to

produce better results also increased. Since 2015, autonomy of schools has been reduced as the Ministry of Education has embarked on putting in place greater controls on schools and school boards. But the greater control is still within a neo-liberal environment. While teachers are employed by the Government, employment contracts have now become the norm. This allows the Ministry greater authority on appointing, elevating, demoting or terminating the employment of teachers.

Cooperative Teaching and learning

Cooperative groupwork learning is where members of the allocated group work with their group members to accomplish a common goal (Killen, 2007). Cooperative learning is considered to be an effective method to improve teaching and learning processes in classrooms (Johnson & Johnson, 1990; 1999). The concept is based on the belief that education should be learner-centered and learner-directed; that learners can be teachers, and that the teacher is a guide and facilitator rather than the source of all knowledge and direction (Coelho, 1994).

To achieve all the goals the members in the group are interdependent; they work with each other rather than working alone. The success of the group depends on the student's ability to cooperate. Students in the group must trust each other, support each other and respect each other to overcome difficulties that may hinder their progress (Kagan, 2004). Cooperative learning does not take place in a vacuum (Johnson & Johnson, 1994). Consequently by dividing or placing students together in different groups in a maths class doesn't mean that cooperative learning is taking place in the class. Cooperative learning is not just simple group work. According to Johnson and Johnson (1994) and Kagan (2004) in cooperative learning the following principles should always be present: positive interdependence, face-to-face interaction, individual accountability, group behaviour, and group processing.

Positive interdependence means that students see the importance of working as a team and realize that they are responsible for contributing to the group's effort. *Face-to-face interaction* involves students working in environmental situations that promote eye contact and social space so that students can engage in discussions. *Individual accountability* suggests that each person is responsible to the group and must be a contributing member - and not be someone who lets others do all of the work. *Group behaviour* refers to those interpersonal, social, and collaborative skills needed to work with others successfully. Finally, *group processing* is a time after the cooperative learning task is finished when team members

analyze their own and their group's abilities to work collaboratively.

An important aspect of the lesson instruction component is the teacher's role. The teacher must (a) have students transition quickly after direct instruction, (b) have activities and materials ready, (c) monitor student progress in groups, and (d) reinforce the occurrences of collaborative behaviours. During cooperative learning activities, teachers should circulate among groups, monitoring students' abilities to complete the assigned mathematics activity and demonstrate the targeted collaborative skills. The teacher can facilitate group work by asking questions to help students redirect their work, by providing additional instruction to some students who may be struggling with the task, and by reinforcing students' efforts for working collaboratively and seeking solutions to problems.

Correspondingly the teacher who is the sole in-charge of his class should play the crucial role in making sure the four principals of cooperative learning are applied to ensure effective teaching and learning is taking place. It is well-established that the employment of new teaching methodology can only come through the teacher (Cohen, 1994; Hintz, 1990; Rich, 1990). The success or failure of new educational ideas depends greatly on the role of the classroom teacher. If the teacher is well versed and trained in use of cooperative learning, and implements cooperative learning with dedication, improvements will be noted in mathematics learning. Learning is identified as social in nature; the teacher functions as a catalyst and not the main source of learning. Student's participation is encouraged, and they are motivated to learn from each other (Cohen, 1993). In cooperative learning teachers are to encourage students to discuss, explain, listen, encourage and provide academic help to their peers (Johnson and Johnson, 1983). In a prudent structuring of cooperative learning students are 'cognitively, physically, emotionally, and psychologically actively involved in constructing their own knowledge' (Johnson et. al., 1992: 11).

There are specific roles that teachers need to follow in order to employ cooperative learning (Johnson & Johnson, 1991). The objective of the lesson needs to be specifically stated by the teacher prior to the class. A well thought out plan needs to be created by teachers to group students. Finally teachers have to monitor and guide group interaction, which is followed by teacher's assessment of group collaboration and student performance. Cooperative learning in mathematics offers pleasant learning situation for all students, as all students have equal opportunity. Competition is amended as friendship, the spirit of cooperation and participation is reinforced and all students are entitled to be thoughtful and creative (Keramati, 2001; Lavasani Khandan, 2011).

Metzler (2011) defines cooperative learning as a methodology in which students learn with, from and for their peers. A cooperative learning classroom should not be teacher-centered; 'ideally teachers are trained to take their existing lessons and restructure them to be cooperative' so as to allow small groups to work together to maximize their own and each other's learning' (Johnson & Johnson, 2008: 26 ;Marashi & Dibah, 2013).

Teachers' Role in Implementing Cooperative Learning

In order to have effective cooperative learning to take place in a mathematics classroom, teachers play a crucial role. To organize effective cooperative learning group, teachers should know their students very well. According to Bettenhausen (2002) a teacher's role in cooperative learning generally includes: grouping students, specifying objectives, explaining tasks, monitoring group work and evaluating achievement and cooperation. Grouping of students can be a difficult process and must be done with care. In a normal classroom there are students who come from different family backgrounds, with different cultural values, beliefs, genders and personalities, and have different learning abilities.

Cooperative learning groups in mathematics class should have a mixture of different ethnic groups, and different learning abilities so that students can work interdependently with their peers sharing mathematics ideas from different cultural perspectives. Smarter students in the group could be classified as 'more knowledgeable others' (MKO) who could provide scaffolding to his or her group members to reach the common goal of the group. Thus in organizing an effective cooperative group, students tend to learn from their peers while the teacher should act as a good facilitator. Rogoff (1990) refers to scaffolding as a specific mechanism used by adults and children during guided participation, comprising a variety of physical and/or verbal aids, aiming at facilitating children's progress towards competence.

If teachers do not provide clear and explicit assistance when students need them, students are unlikely to engage in task-specific learning (Cohen, 1994). Lack of teacher assistance has been found to be the most important reason for low achievement of students in group-learning settings (Webb, 1989). For any lesson the teacher takes, the lesson plan acts as a good road map to achieve what is expected in that lesson. Thus in a mathematics class, teachers should devote ample time to prepare effective lesson plans for cooperative learning.

In planning a cooperative mathematics lesson plan a teacher should see that he/she has included relevant teaching aids which will be used by

the students to practice hands-on activities which will be connected to real life situations in local contexts. Thus a well-planned cooperative lesson will have a space where children will be given an opportunity to teach themselves and each other in the same group. By teaching and helping each other in the groups students will actively engage with their peers.

Secondly mathematic teachers should take note that relevant specific measurable objectives are stated which will provide a sense of direction. Through assessments, oral questioning, observation and group activities the teacher has to re-plan and re-teach the same concept if the objectives are not being met.

During group-work monitoring, a teacher is 'both an academic expert and a classroom manager' (Johnson & Johnson, 1990: 112). The teacher monitors the functioning of the learning groups and intervenes to teach collaborative skills and provides task assistance when it is needed. Though he remains the technical expert, the teacher functions more as a consultant to promote effective group functioning. Typical statements a teacher may make are, 'Check with your group'; 'Does anyone in your group know'; 'make sure everyone in your group understands' (Johnson and Johnson, 1991: 61).

It ought to be noted that there remain significant differences on methods proposed by proponents of cooperative learning for effective outcomes. Kagan (1985) suggested that teachers should be freed even more in group investigation to allow students to assume responsibility for learning. Teachers typically consult with groups and suggest ideas or possibilities for exploration. Cohen (1991, 1994) observed that students reduced the amount of cooperation and communication between each other after the teacher intervened. Therefore, he proposes minimizing monitoring to help students become more interdependent, autonomous, and self-directed. His preferred method is to use the quick-response strategy in which teachers provide brief comments and questions, then move away from the group so that students can continue their discussions.

Johnson and Johnson (1990), Kagan (1985), and Cohen (1991, 1994) encourage teachers to monitor the group's on-task behaviour and cooperative skills and to provide task assistance when necessary. Therefore, the teachers' role in cooperative-learning classrooms is aimed at helping 'improve effective group functioning than an instructor who contributes information or scaffolds students' learning' (Meloth & Deering, 1999: 244).

Finally in the evaluation phase or at the end of a cooperative mathematics lesson, teachers need to evaluate students' learning and give feedback on how their work compares with the preset criterion of excel-

lence (Johnson and Johnson, 1986). The cooperative mathematics group then processes the information, assesses how well they have worked together, and plan on improving their effectiveness for future activities.

Thus, in cooperative learning there is a shift from teacher centered to student centered activities where students are given opportunity to teach each other, share ownership of content, and construct new knowledge (Hannon and Ratliff, 2004). In cooperative learning mathematics classroom teachers should take an important role in organizing and managing the classroom. Consequently, a well-organized teacher will make sure that relevant teaching and learning materials are made available so that students need not run around and search for them. The classroom should be well set up, and be safe and conducive towards learning.

Teachers need to understand the essential elements of cooperative learning to enable them to employ effective methods in mathematics classroom.

Slavin (1986, 1987) proposes three essential elements in an effective cooperative learning method. First, the role of the teacher here is to provide some type of meaningful reward to group members to encourage that desirable behaviour occurs again. In order to have positive effect of cooperative learning take place in a classroom, students must be motivated; it is that intrinsic motivation, the desire to learn and achieve the most, which is important. This comes from the learner himself. Looking at extrinsic motivation, the teacher as the facilitator of cooperative learning plays a crucial role by motivating students using rewards and praises to enable students to maintain their interest and desire to learn what is being taught. Positive classroom culture includes teacher receptiveness to students' ideas, equality (and not just control or domination), and honesty, warmth and friendliness (such as smiles, eye contacts, reassuring gestures); teachers do not act on a stage but walk around the classroom (Jolliffe, 2007). In addition to this teachers need to respect the pupils feelings (empathy), putting themselves in the pupils shoes.

The second element is individual accountability. The teacher should make sure that each member is given equal opportunity to demonstrate knowledge learned in the group without the help of other group members. Thus a good teacher should assign individual responsibility to students in groups which will encourage students to perform their given responsibility. Students in groups can take the role of explainer, recorder, checker and encourager. Thus with the assigned roles students will feel part of the group and participate effectively.

Killen (2007) supports the view that teachers need to ensure that every student has an opportunity to talk about their learning, exchange

ideas, think critically and help others to learn. Teachers need to train students to record and describe members' behaviour in their group. In addition the teacher should help students to believe that they will be better off if they worked together productively. The teacher should help students to understand the skills and give students opportunities to practice skills regularly (Graves and Graves, 1990). Teachers should teach students how to do each of the assigned group task, how to help members without doing the job for them and how to check on what their group members are doing by listening, encouraging and suggesting (rather than taking over) (Cohen, 1994).

The third essential element of cooperative learning in mathematics is that teachers should encourage equal opportunities for success by forming heterogeneous groups. Students are not of the same learning abilities; some are slow learners and some learn fast; some learn skills and concepts just through teacher explanation, while some need greater scaffolding to move on with the task. To assist slow learners teachers need to prepare tasks that take into account each group member's strengths and weaknesses. In designing the task structure of learning activities and social skills, mathematics teachers need to consider the cognitive ability and social skills required to undertake activities cooperatively (Corden, 2000).

Conclusion

For successful implementation of cooperative learning in mathematics classrooms, mathematics teachers must have a good understanding of cooperative learning and its elements. They need good classroom management skills to manage time and students' work towards effective learning. Cooperative learning in mathematics reduces teacher talking time and gives more opportunities to students to learn through social interaction. Of critical importance is the need for the teacher to plan and prepare the activities appropriately. As a good mathematics teacher clear lesson objectives need to be stated for each mathematics lesson. This will provide the students a sense of direction. In any cooperative group work everyone is a part of the team and each member's active participation is required. The teachers should set a conducive classroom environment, prepare adequate learning resources, and motivate and encourage students towards active participation to achieve academic outcomes.

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