Investigating the Effectiveness of Collaborative Learning in Using the Snowballing Effect Technique

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ABSTRACT

In this study we investigated the effectiveness of collaborative learning in the context of small-group discussions through the snowballing effect technique. The study was conducted in one of the Vocational and Technical institutions in Brunei Darussalam, which offers Travel and Tourism Services. The two chosen mathematics topics in this study were the measure on central tendency and sets. A group of 18 students having at least a pass in their previous secondary school national examination was selected to participate in this study. Data was collected through a series of tests, students' interviews, class observations and by collecting students' artifacts. The findings showed that when a snowball effect technique were introduced and used in the small-group discussions there were improvements in the students' test performances. The use of these techniques and approaches had certainly improved the students' learning experience and may also help instructors better utilize their time by conducting collaborative learning approaches in their future mathematics lessons.

Keywords: Snowball effect, small-group discussions, mathematics, vocational and technical education

INTRODUCTION

A snowball effect is a classroom based activity where initially, students are grouped into pairs and then they slowly form a bigger group of four to eight students in order to proceed to the next level of discussion. Through the snowballing practice, the bigger the groups formed, the more information the students would gain during their discussions and hence the snowball effect. It will then be followed with a whole class discussion, so that all the students can share collaboratively what they have gained and fill in any gaps in the information they have received.

According to Davidson and Kroll (1991), collaborative learning happens in a small group setting where students share ideas and work together to accomplish certain goals. Collaborative learning diverges from traditional methods that are based on personal performance and competition. However, there are potential problems with individualized programs (Endsley, 1980). First, they require self-discipline, self-confidence, motivation, and ability to work alone. Secondly, individualized programs require strong reading skills. If the program is not a good fit and the children do not have the necessary skills, they fail (Endsley, 1980). Elementary students working in pairs participate in a far more superior mathematics learning experience than those who sit in classrooms where the teacher lectures (Fuchs, et al., 1997). Studies have shown that underachieving students are better able to understand their peer's explanation than they grasp from the teacher or the book (Mevarech, 1985). However, Webb (1991) stated that it must be structured to ensure consistent benefit to the parties involved.

There are many types of collaborative learning groups that can be clearly defined (Davidson

& Kroll, 1991). Webb (1991) also believed that by analyzing the types of feedback and questions occurring in the group setting, collaborative learning could be structured in a way that benefits all students in a statistically significant way. Slavin (1987) stated that the teams work together to learn and everyone must understand the concept to maximize the potential of reaching the learning goals. Furthermore, Jacques, Wilton and Townsend (1998) mentioned that students with slight learning disabilities were more accepted by their peers when collaborative learning was used. Though their peers expressed initial fear about interacting with the disabled students, they became more confident as they learned appropriate responses to their partner (Clement, 2002).

Teacher's Roles and Responsibilities

Teachers should provide opportunities for learners to share their thinking and problem-solving processes, justify and formulate conjectures publicly, and evaluate multiple solution strategies (Franke, Kazemi, & Battey, 2007). To ensure high-quality mathematical discourse or discussion, teachers must structure conversations and communication around a particular problem and solution methods (Wood, 1998). Yackel, Cobb and Wood (1991) also stated that teachers must engage all students in classroom discussion, including struggling students. According to Franke et al. (2007), teachers have to respond to a variety of student responses in ways that illuminate and amplify essential mathematical understandings. The enactment and facilitation of high-quality, content-rich classroom discussion is not easy. It demands that teachers attend to students' thinking both individually and collectively, aligning one student's thinking with another while also aligning student talk with the content and essential mathematical ideas (Ball, 1997).

An important aspect of classroom discussion is how teachers recognize errors in students' solution strategies and understandings of mathematical ideas. And also how teachers make productive use of such errors. Errors can be detrimental to learning when they are not responded too effectively (Touchette & Howard, 1984). Teachers can use errors that become apparent during classroom discussion as instructional leverage to make explicit the key concepts and tools of inquiry needed to understand and apply a mathematical principle. Properly responding to errors provides critical entry points for teachers to facilitate learning for all students.

Small-Group Discussions

According to Madden et al. (1997), students could reach success as long as they reach the level of proficiency. When students realize that their ability to obtain rewards is based on their fellow group member's progress, they will be more willing to encourage and explain the concept to their teammates (Nichols & Miller 1994). Studies actually show stunted growth in certain cases without rewards (Slavin, 1996). However, some studies have shown that students can be challenged to elaborate and reason through deeper levels of relevant material as a team without the reward (Yackel et al., 1991). In the study by Wong, Lawson and Keeves (2002), the group of students that elaborated earned a better score than those who did not elaborate. Yackel et al. (1991) also believed that rewards and patterned interaction are necessary.

According to Chizik (2001), discussion includes all members because they feel that they all have something to contribute and that students must show a statistically significant change in their achievement due to group work. Relating to several studies, Webb (1991) stated that students like working with a partner and will turn to him or her for advice before asking a teacher. This makes it easier for the teacher to give one-on-one help to those who needed it and lighten the demand for his attention (Chizik, 2001).Furthermore, students who are shy or

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afraid to ask questions from their teacher may also prefer to work collaboratively with peers in solving mathematical problems (Salam & Shahrill, 2014; Shahrill, 2009; Shahrill & Clarke, 2014; Shahrill & Mundia, 2014).

When establishing the initial conceptual foundation, immediate intervention is vital to the perseverance and ultimate success of each student. When fellow students respond to the questions about their area of struggle right away with a detailed answer, students develop a much stronger understanding of the problem; they succeed because of the additional practice they are able to accomplish (Abrami & Chambers, 1996). This produces a setting where interpersonal needs are met. In addition, group members encourage others to succeed because they need the rest of the group to do well individually in order to receive a reward (Madden et al., 1997).According to Slavin (1996), this is necessary when the groups are not voluntary, all members are required to complete the task and the group is searching for specific answers to each problem. Various methods of motivation are needed in these cases to encourage students to follow the program structure and pattern of dialogue to ensure the success of the cooperative group. Rewarding improvement leads to challenging each other to do better.

AIM OF STUDY

The aim of this research study is to enable teachers to better utilize their time by allowing the students to work collaboratively through small-group discussions and simultaneously to encourage the students to assist one another. In this study, we investigated the effectiveness of small-group discussions using the snowball effect technique in a vocational and technical Mathematics lessons. In Brunei, Mathematics is one of the subjects that consistently challenged students at the post-secondary vocational and technical education level (Ahmad & Shahrill, 2014; Daud & Shahrill, 2014; Tahir & Shahrill, 2014). With the education reform in Brunei, major developmental changes are expected in the technical education sector (Ministry of Education, 2013). This study sought to investigate the following research questions:

1. How effective is the snowballing effect technique used in a vocational and technical mathematics lesson?
2. What are the factors that are needed to have an effective snowballing effect technique in a mathematics lesson?

METHODOLOGY

Participants and Procedure

A class of 18 diploma students in Travel and Tourism Services at one of the vocational and technical institutions in the Brunei-Muara district in Brunei Darussalam was chosen for this study. The two Mathematics topics chosen for this study were Measure of Central Tendency and Sets. Measure of central tendency only covered the calculation of mean, mode and median of group and ungroup data. Meanwhile, the topic sets only covers the basic set theory.

Teachers play a vital role in ensuring the success and effectiveness of the small-group discussion or the snowball effect. One of the authors also acted as the facilitator throughout the lessons. The 18 students were divided into a group of six before proceeding to a whole class discussion. This was to ensure that the number of students in one group was balanced. There were three students who achieved a grade C or higher in their end of secondary schooling examination, and the remaining students attained a grade D or below. The facilitator made certain that the three students were not allocated in the same group in order to have a relatively balanced group in terms of their mathematics skills.

In each lesson, a problem sheet was given to the students for them to work on in pairs.

Subsequently, the pairs proceed into a group discussion of three students and finally end with a whole class discussion to share all the information that they have gathered and to justify any misconceptions if any. The facilitator did not provide solutions to the problems given. Before intervening any group discussions, the facilitator stood back and listened to students' discussion to see if there was any need for intervention. The purpose of an intervention was to increase the depth of reflective thought, challenge the students to describe, explain and interpret what they were doing. It was also done to ensure that the students really do understand the content.

Data Collection and Analysis

The data was collected through a series of tests, students' interviews, class observations and by collecting students' artifacts. The study started with a pretest to test students' prior knowledge on both the topics. The facilitator used students' pretest results to determine the specific area that needed more focus in the topics. The two topics were taught during their secondary years. After the intervention lessons, posttest papers were given to the students to measure the students' individual understanding on the topic content. Students' pretest and posttest scores were analyzed using simple descriptive statistics to see how well the students performed through small-group discussions.

Individual interviews as well as a focus group interview were conducted with six volunteered students. A focus group interview was done in order to examine if there were any changes in the students' perspectives or attitudes towards mathematics when asked individually and in a group. Individual interviews were done before the focus group interview.

RESULTS AND DISCUSSIONS

The results of the tests showed an increase between the pretest and posttest scores for both topics (refer to Figure 1). For the topic measure of central tendency, students' pretest scores ranged between 15% and 92% whereas the students' posttest scores ranged between 54% and 100%. The posttest was then given after a several lessons were conducted and the result showed that the students' performance had improved from their previous pre-test. Almost all students had achieved at least 85% except for one student. Out of the 18 students, six of them scored 100%.

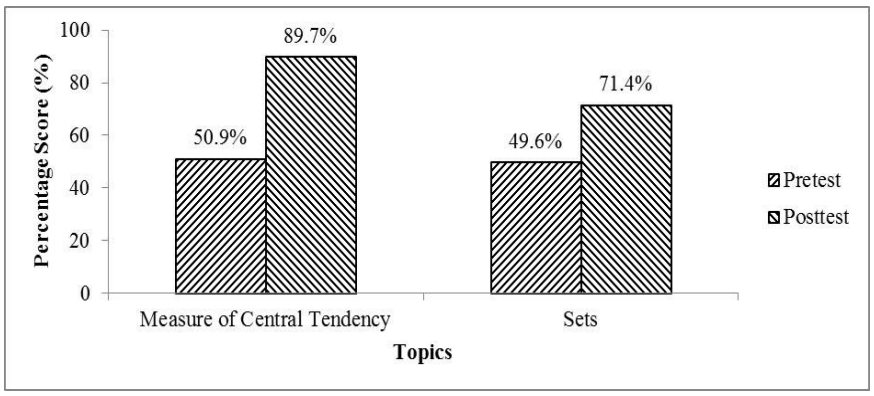

Figure 1. Percentage mean scores

Meanwhile for the topic Sets, students' pretest scores ranged between 29% and 86%. The students' pretest scores on Sets shows that the students' pre knowledge on sets was quite under par. With an overall average mark of 49.6% for the pretest and eight of the students scored lower than 50%. Posttest was then given after several lessons conducted. The result has shown slight improvement from their pre test 49.6% to 71.4%. However, the students'

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improvement in the topic is not as significant as their increase in score for the topic measure of central tendency.

During the first few lessons, some students showed no interest at all to work in groups. Some even approached the facilitator personally and said that they preferred to work with the facilitator rather than having their friends to discuss with. Pairing the students up was also a challenge as some of them preferred to be in a bigger group and their partners intimidated some of the students. Fortunately after a few sessions they got along with their partners really well and their discussions improved, as they slowly understood the need of their partners. At times, the facilitator had to intervene the students if one student was dominating the discussion. The facilitator would encourage the other students to join the discussion as well. Through our observations, the students were immersed in the discussion and tried so hard to solve the problems given. From the observations also, the authors detected another problem as to why the students were unable to perform as well as they did in the first topic. The students claimed that they have low English proficiency level; students found difficulties in understanding the questions. They were unable to draw attention to the keywords given in the questions.

Interview Findings

The interview was conducted several weeks after all the lessons were completed for both topics. The interview was initially done individually and then in a focus group setting. There were six students who volunteered for the interview. The nature of the interview was informal and the purpose of the interview was to see if there is any notable difference in both of the interviews. From the interviews, it was found that four out of six students interviewed preferred to have the small group discussions. They claimed that it strengthened their communication skills and their understanding. One of the students mentioned that he understood the way to find a median of a given data better through the discussion. He was not afraid to ask his partner to explain. He himself stated that he was a slow learner and he had to ask his partner to explain the method used more than twice. He was also thankful that his partner was very helpful and sincere. This implied that having the right partner for an effective discussion is vital.

Another student pointed out the importance of teamwork and in knowing their responsibility in the small-group discussions. She brought up the importance of ensuring all the teammates in understanding the method for the purpose of the whole class discussion. Having all team members explain various methods also made them think conceptually. By doing so, they can come up with the shortest and easiest way to solve a given problem. Working collaboratively also strengthened the students' friendship, which one of the students found is important. With that, they were able to know their teammate's strengths and weaknesses and as a result, easier for them to explain and discuss the problems.

CONCLUSIONS

From the results of the analyses of the pretests and posttests of the topics measure of central tendency and sets, it has shown that there exists an improvement in the students' performances especially on the first topic. Students' overall performance has increased by at least 30 % in both topics. There are several factors needed in order to have an effective snowballing effect technique in small-group discussions in a mathematics lesson, namely:

1. Students' attainment and attentiveness in the discussions. Equal opportunities to speak up are important.

2. Every student holds the responsibility of his or her group members. Every group members have to make sure that everyone in their group understands what was discussed and is confident in defending their answer during the whole class discussions.
3. Teachers should avoid the habit of providing solutions to the students. Let students discover themselves. Appropriate facilitation and assistance are required to make sure students are on the right track.

The present study was conducted with the aim of improving the teacher's teaching by utilizing their time better through a small-group discussion on a daily basis and at the same time to boost students' mathematical communication and thinking skills. Furthermore, we observed that the students enjoyed their mathematics lesson better as they were more engaged in the mathematical discussions. Students were found to continue their discussions even after class. Students were also found to be more daring in asking questions, they were not afraid to speak up even if their answers were incorrect.

IMPLICATIONS & RECOMMENDATIONS

For this present study, it has been proven that the students understood and performed better in their tests through collaborative learning using small-group discussion. It stimulates and challenges their thinking ability. At the same time, it also improved their communication skills when they move on to explaining their work to the team. As was discussed earlier, students were made clear of their responsibility at the start of the activity. Based on the findings and conclusions of this study, the authors strongly recommend further research to be done on collaborative learning on small-group discussions through a snowball effect to a bigger group sample.

In Brunei, there are shortages of relevant mathematics instructors in the vocational and technical institutions, and the numbers of students accepted into the institutions are increasing rapidly. The ratio of students to each teacher will also increase, and thus the amount of time needed to focus on each student may decrease. Snowballing effect is a learning technique that can be done in a bigger group; hence there are more opportunities for future researchers to conduct researches at the higher level for example, at the college or at the university levels.

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