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The effectiveness of student teams-achievement division (STAD) cooperative learning on mathematics achievement among school students in Sarikei District, Sarawak

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Abstract
This research aims to identify the effectiveness of Student Teams-Achievment Division (STAD) cooperative learning techniques towards Mathematics achievement in Sarikei District, Sarawak. The number of subjects involved this research is seventy students from Year Five in Sarikei District, Sarawak. 35 students were in the experimental group – 20 males and 15 females – while another 35 students were in the control group – 19 males and 16 females. Data collection was done twice which were the pretest and the post test. The gap between the exam was four weeks. The Mathematics test has 20 items which consisted of 10 comprehension items and another 10 communication 10 items. The questions were adapted from Primary School Assessment Test (*Ujian Pencapaian Sekolah Rendah*). The data was analysed with mixed between-within subjects ANOVA. The findings of this research have shown that STAD techniques in Mathematics learning can increase Mathematics achievement. This research has also shown main effect and direct interaction in students' Mathematics achievement in the posttest between the experimental group and the control group. This shows that STAD cooperative learning techniques play important roles as an active pedagory to increase Mathematics achievement. STAD encourages the students and teachers to be innovative and creative to improve teaching and learning of Mathematics in the classroom. These benefit the students in Sarikei District and enable them to compete healthily with the other students from urban areas in Mathematics.

Keywords: Mathematic achievement, STAD cooperative

Introduction

The national education system has contributed a lot of development from a variety of perspectives especially in the context of individual's character development and economy. Education aims to build a firm foundation for a country's development and also to take on the challenges of creating individuals who are resistant, progressive, knowledgeable, creative and able to compete on a national level. Therefore, the role of the Ministry of Education in Malaysia is to fulfill those aspirations by increasing our education quality. This is done by providing effective training, having sufficient facilities, ensuring equality of education development in the rural and encouraging innovation in teachers' teaching and learning. All these aspects aim to continuingly enhance a teacher's quality and self-development from the first day they were posted as a teacher (Muhamad Sidek Said, 2007) [13].

The emphasis on quality education is the right step to fulfill current demands in today's teaching and learning. To create an excellent organisation, one needs to have a positive attitude to problems. The success of a quality education leads to the success of an individual's self-development. Many papers have shown that students who achieve excellent results are influenced by teachers who have high capability in many fields. (Goddard, Hoy & Hoy, 2000; Stronge & Trucer, 2000; Ebmeier, 2003; Van Dat Tran, 2013) [6, 17, 5].

Student achievement is influenced by a teacher's teaching methods and his or her commitment (Joffres & Haughey, 2001; Zakaria & Iksan, 2007; Norziah Othman, 2014) [7, 19]. With this fact, a teacher should always be proactive by implementing new programs, offering effective strategies or techniques that will improve and enhance normal teaching methods or paying attention to do improvement on available practices or policies to improve teaching (Ebmeir, 2003; Astor, 2005) [5, 4]

Cooperative learning is a learning approach that was introduced in American schools in the early 1800s. The trend of cooperative learning is pioneered by Colonel Francis Parker. He was invited by the Quincy Education Committee, Massachusetts to improve their schools' education system as the schools were unorganised. Parker had introduced and developed 'Quincy Plan' that was based on students learning and doing activities in a group. Moreover, the students carry the responsibilities of their group mates' learning as well (Melihan & Sirri, 2011).

The growth of theories, research and usage of cooperative learning happens tremendously in the next 50 years when two German followers, David and Roger Johnson, adapted the cooperative learning methods that were used by the Germans in universities and applied those methods in the classrooms. This cooperative learning model is known as 'Learning Together' (Scearce, 1992). This model lists out basic principles for the educators to come out with new ideas while implementing cooperative learning in their subject matters and in every classroom (Zakaria & Iksan, 2007) [19] .

At the same time, Robert Slavin from John Hopkins University in Baltimire had added several vital elements in the structuring process of group learning approach that was introduced by DeVries. These changes left a deep imprint to the students. According to Slavin (2011), cooperative approach requires the students to cooperate with one another to learn. The students are also responsible on the learning of their group members as well as their own learning (Slavin,

2011). Other than the idea of working together, this method also emphasises on achieving group's goals and group's successes. These can only be achieved when all group members have learned the intended objective. For example, the learning techniques that are based on group learning are Student Team-Achievement Division (STAD), Teams-Games-Tournaments (TGT), Team Assisted Individualization (TAI) and Cooperative Integrated Reading and Composition (CIRC). Spencer Kagan (2001) [11] from the University of California had also done a research on the effectiveness of cooperation learning towards students' academic performance and social relationship. Kagan had introduced and developed structured approach to increase students' interaction in the classroom while cooperative learning is ongoing. There are four important elements in Kagan approach (2001) [11] including cooperative group, cooperative management, goals and learning objectives. The four principles (PIES) in cooperative learning are Positive Interdependence, Individual Accountability, Equal Participation and Simultaneous Interaction.

Cooperative learning is a student-centered method that focuses on group works in a classroom based on a fixed procedure (Johnson & Johnson, 2005). Cooperative learning is a teaching method that encourages students to work and learn together in a small team (Johnson & Johnson, 2008). This learning method encourages students to interact actively and positively in a group. Students can exchange ideas and they are more willing to come out with new ideas in a safe environment. This is on par with constructivism philosophy (Tran & Lewis, 2012). Another type of cooperative learning is Student Teams-Achievement Division (STAD). The process of cooperative learning and teaching that is developed by Slavin is a learning method that can unite the learning group to improve Mathematic achievements by concept comprehension and communication (Melvin & Silberman, 2006).

Ali (2010) said that Mathematics is a basic knowledge that is gained from lower education until higher education. Elizabeth and Conroy (2009) stated that one of the goals in Mathematic learning is to provide endless opportunities to students to expand and integrate Mathematic knowledge, skills and practices.

Methodology

This research is implemented with quantitative approach. The subjects of this research are seventy Year Five students in a primary school in Sarikei, Sarawak. 35 students are in the experimental group while 35 students are in the control group. Experimental group are exposed to STAD cooperative learning, while the control group is given the traditional teaching method. The teacher who implemented the STAD cooperative learning underwent training on the use of cooperative learning in order to ensure that it would be implemented as planned. Upon completion of instruction, post-tests are to be conducted to determine the difference between the groups. Instruments used in this study are the mathematics achievement tests which is measured using performance test tools. The test consists of twenty items of open-ended questions cover the syllabus of fraction in year five and adapted from Prmary School Assessment Test. The reliability coefficient of the test was found to be 0.81. The researcher in collaboration with the mathematics teachers have developed the questions. The content of the tests is validated by a group of experts in mathematics education. This test is given to both groups before and after instruction is completed. Data gathering is done twice – pre-test and post-test. The time duration for this research is four weeks. The data is analysed using mixed between-within subjects ANOVA.

Findings

Analysis of STAD Technique Cooperative Learning based on Student Achievement in Mathematics

H_0: There is no significant difference between STAD cooperative learning with student achievement in Mathematics.

Descriptive Statistics

Table 1.1 shows that the score of Mathematics achievement test in experimental group and control group. The mean score for pre-test shows that the experiemental group (mean = 16.37, SD = 6.64) and control group (mean = 16.37, SD = 6.30) have similar mean score in Levene's test. The mean score is similar and there is no significant difference. The test results from post-test show that the findings from the experimental group (mean = 35.34, SD = 7.45) is higher than the findings in the control group (mean = 29.6, SD = 7.43). This shows that the experimental group has shown higher implication in comparison to the control group.

Table 1.1: Mathematics Achievement Test for the Experimental and the Control Group

Mathematics Achievement Test	Experimental Group			Control Group		
	N	*Mean*	*SD*	*N*	*Mean*	*SD*
Pretest	35	16.37	6.64	35	16.37	6.31
Posttest	35	35.34	7.45	35	29.60	7.43

The Assumption of Homogeneity of Variance for the Experimental Group and the Control Group

Table 1.2 shows that Levene's test is not significant (p>.05) in the pretest for the experimental group and the control group. The result from Levene's test shows that the assumption of equal variances in the pretest for the experimental group and the control group is the same.

Table 1.2: Levene's Test Results for the Experimental Group and the Control Group

	Experimental Group		Control Group	
	F	*Sig.*	*F*	Sig.
Equal variances assumed	0.415	0.522	1.179	0.281
Equal variances not assumed				

Next, Table 1.3 shows the resulf for Box's Test of Equality of Covariance Matrices is not significant (p>.05). The results from Levene's Test and Equality of Covariance Matrices have fulfilled the assumption of homogeneity of variance for the experimental group and the control group and are the same.

Table 1.3: Box's Test of Equality of Covariance Matrices

	Results
Box's M	5.934
F	1.947
dk_1	3
dk_2	3427920.000
Sig. (p)	.120

Interaction Effect

Before looking at the main effect of the test, first, one should know the effect of interaction. Table 1.4 shows that the test result for multivariant has shown the interaction effect between factor 1 and group. The interaction effect shows a significant result (*wilks'Lambda* = 0.960, p < .05). This shows that there are interaction effects between experimental group and control group on Mathematic achievement test. The interaction effect in the experimental group is disordinal interaction type because STAD techniques cooperative teaching can improve Mathematics achievement and this relationship is positive (pre to post).

Main Effect

Table 1.4 also shows factor 1 in Mathematics achievement in the pretest and the posttest is significant (*wilks' Lambda* = 0.100, p < .05). This result shows that STAD cooperative method has an impact towards improvement in Mathematics achievement for students in the experimental group. Although there is a significant difference in Mathematic achievement between experimental group and control group, the result of the study is ascertained by obtaining the size effect from partial eta squared test. It is discovered that the result for size effect is big (λ = 0.900) according to Cohen (1988).

Table 1.4: Multivariate Test for Experimental Group and Control Group

Effect		Score	F	Df	Error df	P	λ
Factor 1	Pillai's Trace	.900	616.602[a]	2.000	137.000	.000	.900
	Wilks' Lambda	.100	616.602[a]	2.000	137.000	.000	.900
	Hotelling's Trace	9.001	616.602[a]	2.000	137.000	.000	.900
	Roy's Largest Root	9.001	616.602[a]	2.000	137.000	.000	.900
Factor 1	Pillai's Trace	.040	2.864[a]	2.000	137.000	.060	.040
Group	Wilks' Lambda	.960	2.864[a]	2.000	137.000	.060	.040
	Hotelling's Trace	.042	2.864[a]	2.000	137.000	.060	.040
	Roy's Largest Root	.042	2.864[a]	2.000	137.000	.060	.040

Between-subjects effects

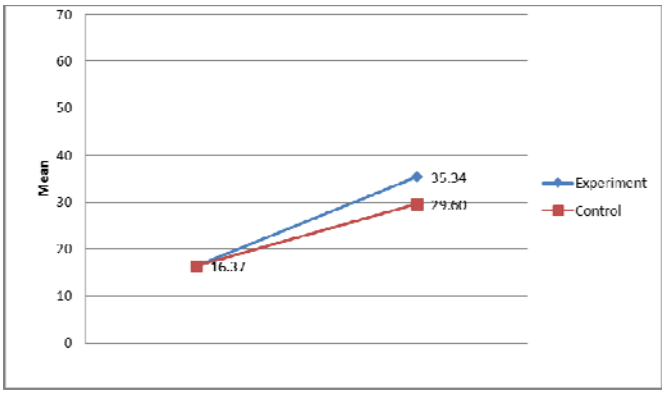
The outcome from the analysis on between-subjects effects in Table 1.5 has shown that Mathematics achievement in the pretest and posttest is significant (p < .05). This matter clearly shows that there is a significant difference in the main effect in Mathematics achievement for the experimental group and the control group. The effects between control subject show large size (λ = 0.839) that supports the signifianct results of this study.

Table 1.5: Between-subjects effects for Experimental Group and Control Group

	Total Power of Two	Df	Mean Power of Two	F	P	λ
Intercept	83496.864	1	83496.864	721.262	.000	.839
Group	288.579	1	288.579	2.493	.117	.018
Error	15975.557	138	115.765			

The data was analysed using mixed between-within subjects ANOVA method. There are interaction effects between the experimental group and the control group towards Mathematics Achievement Test is significant (*wilks' Lambda* = 0.100, *p*<.05), and the main effect of Mathematic achievement in the pretest and posttest is significant (*wilks' Lambda* = 0.960, *p*<.05). The main effect of Mathematic achievement results towards the experimental group and the control group is also significant. (F=721.262, *p*<.05, λ=0.839).

Picture 1.1 shows the mean score for pretest – the experimental group (mean = 16.37, SD = 6.64) and the control group (mean = 16.37, SD = 6.30) assumed the same based on Levene's Test. The mean score results for Mathematics Achievement Test in the posttest for the experimental group (mean = 35.34, SD = 7.45) outperform the control group (mean = 29.60, SD = 7.43). This shows that there are significant differences in the Mathematic Achievement Test results for students in the experimental group for both pretest and posttest.



Picture 1.1: Mean Score Profile on Mathematics Achievement by Experimental Group and Control Group

Discussion

This research has shown that the effectiveness of using STAD techniques cooperative learning towards Mathematics achievement. The findings of this study show that the mean score of Mathematics achievement in STAD technique

cooperative learning is higher than conventional learning. The findings of this study is parallel with a research done by Slavin (1996) [15, 16] who stated that cooperative learning method can give an impact on students' Mathematics achievement. This is because cooperative learning methods that are implemented through group discussion encourages students to interact with one another to increase their ability to process information. This leads to better Mathematics achievement among students. The findings of this study is reaffirmed by the opinions given by Johnson & Johnson (1985) [8, 9] who stated that students who helped their peers in sharing information through group discussion, can encourages themselves to get better academic results. The findings of this study is also parallel with the research done by Adeneye, Alfred and Samuel (2012) [1] who researched the effects of variance comparison in cooperative learning methods towards Mathematic achievement for students in Nigeria. The findings showed that there were significant differences in students' Mathematics achievement towards cooperative learning methods. The research had also discovered that cooperative learning method is able to increase the mastery of Mathematics syllabus among the students.

Besides that, this research is also parallel to studies that was one by Ali, Seyed, Manijeh and Hassan (2007 and Arsaythamby and Sitie Chairhany 2012) [2, 3]. Those studies have shown that there are significant changes between the pretest and the posttest in cooperative learning group but there are no significant changes in conventional learning group. This fact proves that Mathamatics achievement in cooperative learning goup is higher than conventional learning. The motivation in students to be involved in learning has also increases in cooperative learning as opposed to conventional learning.

The same goes for a research done by Kagan (2003) [10] that stated students who learn in a group and with cooperative learning are more active and have shown positive effects on Mathematics achievement. Cooperative learning has also helped to repair the ethnic and race relationship, enhance social skills and improve social relationship. A team also brings a sense of belonging among the students. This encourages a free-stress situation in the learning process. This research is parallel with Yamarik research (2007) [18] that discovered cooperative learning in Mathematics leads to better results than conventional learning. This matter is proven through the increased interaction between students with students, students with teacher. Students are in a relaxed learning situation and this encourages them to be more forward in asking questions as a group, rather than as an individual. With this, the improvement in students' quality of learning for examination when they are in groups, has ignited huge advantages to learning materials.

The outcome of this research is also supported by Rahadi (2002) [14] who stated that students' Mathematics achievement has become better when using cooperative methods as opposed to conventional methods. In cooperative learning method, students have the ability to compete and to cooperate until the students become active and creative in the learning process. This directly affect and influence the students' Mathematic achievement.

Conclusion

The results reveal that cooperative learning can increase mathematics achievement. Cooperative learning also enhances understanding and self-confidence. These results would imply that incorporating cooperative learning in the mathematics classroom would enchance the learning of mathematics in primary school. Implementation of STAD cooperative learning should be reviewed in terms of knowledge and skills of each teacher. In this case, training and continuous professional development is needed for teahers, and collabration among teachers should be encouraged through holding regular meetings, both formal and informal. Teachers can learn from each other and can examine the strengths and weaknesses of the instruction that has been implemented, and their experience can be shared with each other to produce better work. Besides, findings of this cooperative learning study should be disseminated to all schools in Malaysia to encourage other teacher th consider the instructional approach. A staff development program should focus on the needs of the teachers. Needs analysis study should be done before running any courses. The courses should be hands-on and the rationale for using cooperative learning in schools setting. Although cooperative learning cannot cure all the problems faced by teachers in teaching and learning in mathematics, it may serve as an alternative to traditional method of teaching.

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