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Collaborative and Cooperative Learning in Malaysian Mathematics Education

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Abstract

Collaborative and cooperative learning studies are well recognized in Malaysian mathematics education research. Cooperative learning is used to serve various ability students taking into consideration of their level of understanding, learning styles, sociological backgrounds that develop students' academic achievement and skills, and breeze the social harmony among students of different ethnic backgrounds. Besides academic achievement, process skills and values are required to extend the social harmony among students in today's multiethnic schools. Therefore, teachers are expected to find the pedagogy that enables students to learn academic knowledge and professional skills to face the challenges in their everyday lives. The Malaysian scholars, based on the findings of their cooperative learning studies, emphasized the use of cooperative learning as an effective pedagogy with the aim to improve students' mathematics achievement and communication skills. This paper describes the role of collaborative and cooperative learning to the development of students' mathematics achievement along with their communication skills and with significant integration of values in Malaysian mathematics education.

Keywords: *Cooperative learning, mathematics education, academic achievement and skills, Malaysia*.

Abstrak

Penelitian pembelajaran kolaboratif dan kooperatif telah diakui dengan baik dalam penelitian pendidikan matematika di Malaysia. Pembelajaran kooperatif telah diterapkan pada berbagai macam kemampuan siswa dengan mempertimbangkan tingkat pemahaman mereka, gaya belajar, latar belakang sosiologis yang mengembangkan prestasi akademik siswa dan keterampilan, dan kondisi sosial di antara siswa dari latar belakang etnis yang berbeda. Selain prestasi akademik, proses keterampilan dan nilai-nilai yang diperlukan untuk memperpanjang harmoni sosial di kalangan siswa pada sekolah yang multietnis saat ini. Oleh karena itu, guru diharapkan untuk menemukan pedagogi yang memungkinkan siswa untuk belajar pengetahuan akademik dan keterampilan profesional untuk menghadapi tantangan dalam kehidupan sehari-hari mereka. Para sarjana (peneliti) Malaysia, berdasarkan temuan mereka menggunakan pembelajaran kooperatif, menekankan penggunaan pembelajaran kooperatif sebagai pedagogi yang efektif dengan tujuan untuk meningkatkan prestasi matematika

dan kemampuan komunikasi siswa. Tulisan ini menjelaskan peran pembelajaran kolaboratif dan kooperatif untuk pengembangan prestasi matematika siswa bersama dengan keterampilan komunikasi mereka dan dengan integrasi signifikan dari nilai-nilai dalam pendidikan matematika Malaysia.

Kata Kunci: *Pembelajaran Kooperatif, Pendidikan Matematika, prestasi akademik dan kemampuan berkomunikasi, Malaysia.*

Introduction

Collaborative and cooperative learning attracts the attention of Malaysian educators in the 1990s and cooperative learning has been implemented to improve students' mathematics achievement, attitudes toward mathematics, communication skills and values at primary, secondary and tertiary levels. Cooperative learning is the instructional use of small groups through which students work together to maximize their own and each other's learning [15]. Cooperative learning is a type of collaborative learning developed by Johnson and Johnson in the 1960s [5]. Collaborative learning refers to a method of teaching and learning in which students work together to discuss, explore, solve a problem, create a project or presentation, debate, and so on [6]. Over the past three decades, the use of cooperative learning has greatly increased. Collaborative learning has grown into structured cooperative group work such as Learning Together model, student teams-achievement division (STAD), teams-games-tournaments (TGT), team accelerated instruction (TAI), cooperative integrated reading and composition (CIRC), Jigsaw, group investigation (GI), etc. Hence cooperative learning activities are structured learning activities in which students work together in small groups to achieve a shared goal. Pressel [23] reported that students in the cooperative learning environment get opportunities to help each other to improve their achievement and retention, increase self-esteem and intrinsic motivation and develop more positive attitudes toward learning skills and social skills. Cooperative learning helps students to learn academic knowledge under the guidance of a teacher and at the same time they can develop communication skills and values through cooperative interaction.

The Malaysian Vision 2020 is an aspiration to thrust the country as a fully developed nation by the year 2020. One of the challenges of the Malaysian Vision 2020 is the

building of a nation that possesses the capabilities of pursuing excellence, whose society is knowledgeable and is respected by others. The Malaysian Education Development Plan (2006-2010) suggested several elements that are considered necessary to equip students with, namely: (i) effective communication skills, (ii) effective ICT usage, (iii) analytical and creative thinking skills, (iv) lifelong learning skills, and (v) ethical values and leadership. As a developing country, Malaysia has been through a lot of changes in development of education. Recent studies on cooperative learning reported that cooperative learning works well at primary, secondary and tertiary institutions in various disciplines like science, mathematics, English as a second language, Malay language, Islamic studies and special education in Malaysian educational context [2], [8], [9], [19].

The Scenario of Mathematics Teaching and Learning in Malaysia

In Malaysian schools, high performance in the examinations especially in the public examinations means everything. Teachers are very concerned with finishing the syllabus and drilling students with the exam answers and questions. They are reluctant therefore to involve other approaches to the teaching and learning of mathematics as it would take up too much time and are deemed irrelevant to passing examinations. The chalk and talk method are dominant in explaining rules, definitions and solving problems [28]. As reported by Harun (2001), matriculation students had difficulties in learning mathematics. Harun mentioned that failures and mistakes are very common when students engaged in solving mathematical problems. In another study, Saleh et al. (2006) found matriculation students are habituated to memorize and apply mathematical rules and definitions and their level of understanding with the facts and formulas are very low. It was revealed in a Matriculation Division (2006) report many students were lacking ability in transforming questions into mathematical sentences and were unmindful during reading questions and identifying the essentials. Some of the candidates were unable to understand algebraic concepts very well [34].

The performance of Malaysian students has been compared with students from 44 countries participating in the trends in international mathematics and science study (TIMSS) assessment [20]. In 2003, Malaysian form two students scored 504, on average, in mathematics. Although this average score exceeded the international average but they were out performed by students from five Asian countries

(Singapore, Republic of Korea, Hong Kong, Taiwan, Japan) and four European countries (Belgium-Flemish, Netherlands, Estonia and Hungary) [29]. As reported in TIMSS [30] which was released by international association for evaluation of educational achievement (IEA), Hong Kong and Singapore were the top performing countries in mathematics for fourth grade (Primary 4). At the eighth grade (Secondary 2), Taiwan, Korea, Singapore and Hong Kong had the highest above average achievement in mathematics. Unfortunately, the findings in TIMSS report 2007 show that there was a drop in Malaysian students' performance in science and mathematics [35].

In Malaysian educational institution, conventional teaching method, i.e. teachers are the focus and students learn through the passive recipient of knowledge, still widely used as a method of instruction to deliver knowledge. This traditional teacher-centered teaching method becomes praiseworthy for the teachers because of its suitability as they can deliver a large amount of information and knowledge through the medium of response and stimuli to many students. Experiencing the significance outcome of student-centered teaching techniques, the Malaysian scholars believe that Malaysian schooling system should move beyond the rote learning method which most considered as methods of the past [12]. Teachers are encouraged to deliver knowledge in such a way that enable students to learn process skills and values while acquiring academic knowledge in today's multi-ethnic mathematics classrooms for their academic and professional development. Various teaching and learning strategies have been introduced for teaching mathematics focusing on student-centered approaches. In the last decade, there is a vast amount of research done on collaborative and cooperative learning in mathematics in Malaysian educational context [35].

Collaborative and Cooperative Learning: An Analysis

Collaborative learning covers a broad territory of educational approaches involving the joint intellectual effort of students, or students and teachers: from small group projects to the more specific form of group work known as cooperative learning [21]. Collaborative learning is an educational approach to teaching and learning that involves groups of students working together to solve a problem. Students in the collaborative learning settings, have the opportunity to converse with peers, present

and defend ideas, exchange diverse beliefs, question other conceptual frameworks, and be actively engaged. Cooperative learning is a type of collaborative learning developed by Johnson and Johnson in the 1960s. Cooperative learning is working together to accomplish shared goals [13]. Cooperative learning is the structured form of collaborative learning, students in the cooperative mathematics classrooms work together by helping, sharing, encouraging each other to achieve a shared group goal. Often the terms collaborative learning and cooperative learning are used interchangeably, although usually they tend to assume very distinct meanings. Collaboration and cooperation happens in both small and large groups leaving the assigned responsibility to the students, cooperation refers first and foremost to small groups of students' working together in a free, fair and congenial environment controlled by the teacher. Therefore, cooperative learning is students' working together to help each other and facilitate each other's learning to achieve a shared goal. In cooperative learning environment, each group forms by randomly choosing high and low-ability students. Students are encouraged to share their knowledge among one another and solve the assigned mathematical problem under the guidance of a teacher to achieve a common goal.

Cooperative learning is an approach under the umbrella of collaborative learning [11], [12]. To establish cooperation in cooperative learning, teacher administers elements of cooperative learning under a cooperative model. Cooperative environment exists when students work together in light of the elements of a particular model to reach a common goal. In absence of any element of the model, it prevails a non-cooperative environment. The elements of cooperative learning models vary from one model to another. The Learning Together, a cooperative learning model, was developed by Johnson and Johnson (1994) [13]. The Learning Together method consists of several elements such as positive interdependence, individual accountability, face-to-face promotive interaction, interpersonal and small-group skills, and group processing. [12], [14]. Learning Together model comprising these five elements play a vital role in the mathematics lesson. Kagan [16] advocates the use of four principles of cooperative learning which are positive interdependence, individual accountability, equal participation and simultaneous interaction. These structures are content-free and activities are created by fitting content into one or more structures. Seven important elements are scrutinized through the analysis of the elements of cooperative

learning from the erudite cooperative learning researches [4]. The elements comprise group heterogeneity, positive interdependence, promotive interaction, individual accountability, interpersonal skills, equal opportunities for success and team competition. Slavin [26] has researched several methods for using cooperative learning in mathematics, each of which he calls Student Teams Learning. One method is called student teams-achievement division (STAD). In STAD, students are encouraged to assist one another to facilitate each other's learning materials to achieve higher group grade. Thus cooperative learning is a form of structured group work with the incorporation of elements such as positive interdependence and individual accountability and so on. It is very clear that just placing students in groups and expecting them to work together will not promote cooperation and learning. It is only when groups are structured following a particular model so that students understand what they are expected to do and how they are assigned to work together for the success of the whole group.

In a cooperative learning environment, students are required to work in teams to complete a common task [3]. Cooperative learning or small group learning approach is a formal form of group work strategy. It allows the students to work together in a group in order to achieve the stipulated mathematics learning outcome. Cooperative learning is used as an alternative to traditional learning as it effectively promotes cognitive and affect outcomes, increases academic performance and helps to develop social skills that are required in the society. It also encourages students to foster interpersonal competencies such as oral communication, active listening, group leadership, the ability to examine assumptions, and the ability to tolerate ambiguities. All of these skills are highly valued in employment [31]. The teaching of mathematics is not about dispensing rules, definitions and procedures for students to memorize but engaging students as active participants through discussion, collaboration and cooperation among students [22]. Therefore, integration of cooperative learning as an effective pedagogy is the demand of era that emphasizes student involvement aiming at acquiring academic knowledge along with skills to face the challenge in their everyday lives.

Cooperative Learning Integration in Malaysian Education

Research in cooperative learning especially in school has been carried out by Malaysian educationists in the 1990s [24]. For the past two decades many studies has been carried out at the primary and secondary levels and the results show students' significant performance, particularly in mathematics by working in groups in cooperative learning environment.

A number of Malaysian educationists like Effandi [9], Zakaria and Zanaton [35], Suhaida [27], Faizah [10], Zainun [33], Mazlan [18], Azizah and Chong [2] have conducted studies on cooperative learning. The findings of their studies show that cooperative learning group, in general, achieved higher mathematics scores than conventional teaching group. Based on the report of Chong [7], cooperative learning has been carried out in Negri Sembilan (1999), Melaka (1999), Selangor (1997-1998), Across 13 states in Malaysia (1998), Kelantan (1998), Pahang (1997), Kuala Lumpur (1996), Sarawak (1994) in various disciplines like science, mathematics, English as a second language, Malay language, Islamic studies and special education. He found cooperative learning, in general, shows better achievement than the conventional method of teaching. It was found most of the studies attempted to compare achievements and attitudes between cooperative learning and conventional teaching. The locations of the study have been mixed: urban, semi urban and rural. The school backgrounds were varied: there were Islamic schools, co-education and non-coeducation, mixed ethnicity schools across many parts of the country. Besides achievements and attitudes, some of the studies focus on process skills and values. There are similarities in the most of these studies; they use quasi-experimental pre- and post test design with instrumentation of pre- and post test, weekly quizzes, questionnaires and observations. The findings indicate, in general, cooperative learning improves achievement and attitudes in promoting process skills and values.

The Impact of Cooperative Learning in Malaysian Mathematics Education

Cooperative learning has been widely proven to have great impact on human development as it is crucial to the improvement of cognitive and affect outcomes, process skills, and values. The effect of cooperative learning in cognitive outcomes, i.e. achievement, and affect outcomes, e.g. attitudes along with process skills such as interpersonal, communication, leadership, creative thinking, problem solving as well

as values - love, cleanliness, rational, sincerity and independent is well established by research (Figure 1) in Malaysia. Effandi [9] conducted a study to determine the effects of cooperative learning on mathematics achievement in the matriculation level mathematics classes. Effandi reported that cooperative learning method is significant in promoting students' mathematics achievement.

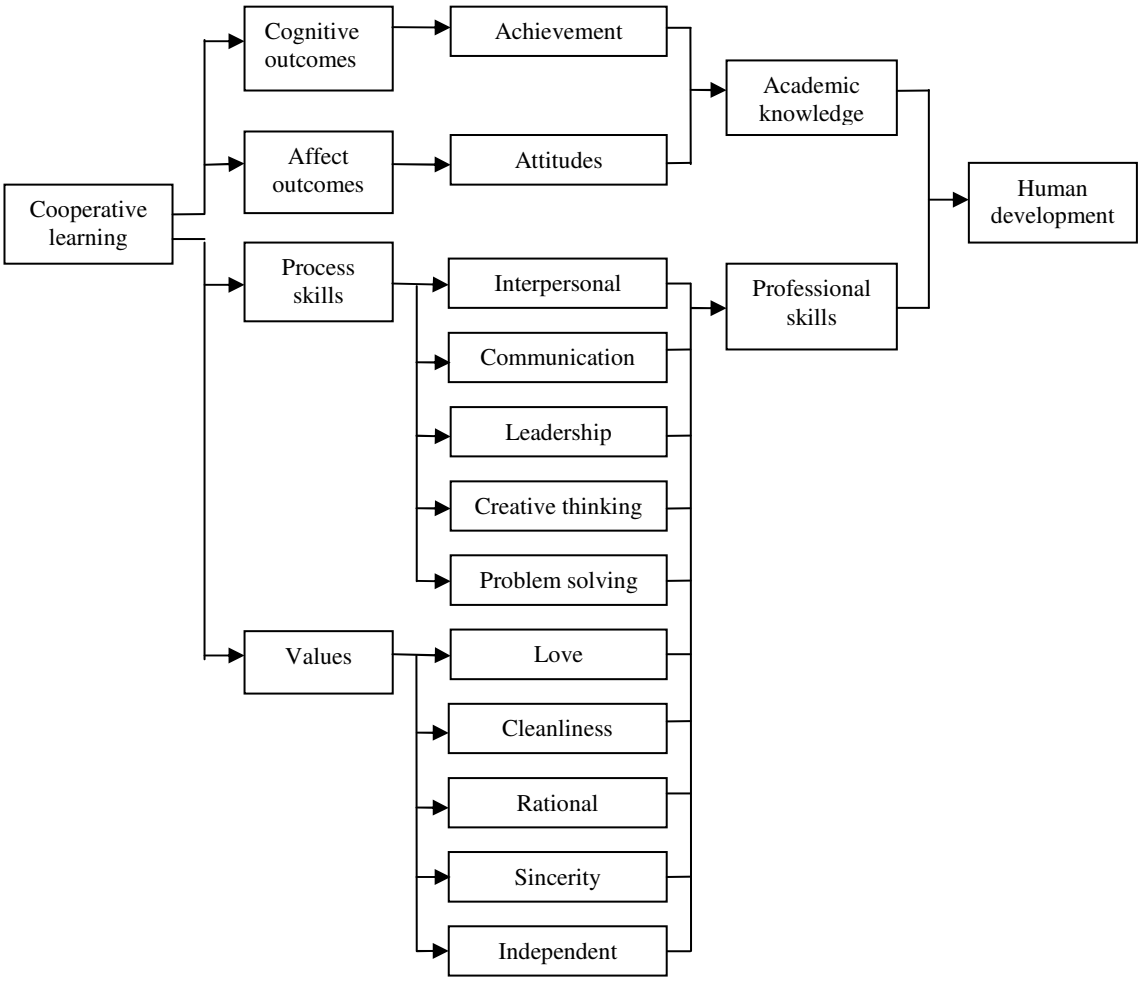

Figure 1: Conceptual framework based on the cooperative learning research

Suhaida [27] investigated the effects of cooperative learning in secondary classes. The study involved two hundred and eight subjects from secondary schools and was conducted over eight weeks. In terms of achievement, the results showed that the cooperative learning group outperformed the traditional group. In another study, Yee [32] found that cooperative learning method increased the mathematics achievement of form four secondary students. Similarly, Lee [17] reported that students in the

experimental group taught using cooperative learning outdone the students of traditional goal structure on mathematical performance. Other researchers also found similar findings as reported by Faizah [10].

Students' mathematics achievement and attitudes toward mathematics are closely related to each other in mathematics education. Attitude has also been the focus of a number of studies in cooperative learning in Malaysian educational arena. A study was carried out by Zakaria et al. [36] to find out the effects of cooperative learning on students' mathematics achievement and their attitudes toward mathematics. It was found that cooperative learning improve students' mathematics achievement and attitudes toward mathematics. Also, Zainun [33] reported from the findings of her study which was conducted using cooperative learning that students show positive attitude toward mathematics. Likewise, Mazlan [18] in his cooperative learning study found experimental students shows positive attitudes toward mathematics in comparison to conventional students.

Like achievement and attitudes, process skills and values that are appropriate in humans' development are also of interest. Azizah [1], in her study in Malaysia involving 966 pupils and using cooperative learning structures, found that cooperative learning has significant effect on values such as love, cleanliness, rational, sincerity and independence. Similar study done was by Siti Rahayah [25] using cooperative learning which involves 1180 students from 18 schools in Malaysia concluded that the values of self dependence, rational, love and process skills such as interpersonal, communication, leadership, creative thinking and problem solving were prominently inculcated. It was found that cooperative learning enhances scientific and process skills, promotes enquiry learning and values, and increases science and mathematics achievement [35].

Conclusion

Cooperative learning has been an interesting and popular area due to its positive impact in Malaysian mathematics education. Various studies have been conducted to examine the cooperative learning effects on mathematics achievement and attitudes toward mathematics and other subjects either at primary and secondary or tertiary levels. It was found that students by working together in small groups were able to gain academic achievement in promoting their interpersonal competencies. All the

research findings, in general, help to afford insights on the suitability of cooperative learning implementation to the development of students' mathematical performance, communication skills and values in the Malaysian educational context. On the whole, cooperative learning models such as Learning Together, STAD, TGT, TAI, CIRC , GI, Jigsaw, Complex Instruction work well for all types of students, regardless of ability levels, learning styles, ethnic backgrounds, age and gender.

References

Azizah, N.S. (1996). Penerapan nilai murni dalam biology melalui pembelajaran koperatif. *Prosiding Seminar Kebangsaan Pendidikan Sains & Matematik*. Fakulti Pendidikan, UKM.

Azizah, N.S. and Chong, P.W. (1999). Status of cooperative learning in Malaysia. *Paper presented at the seminar on Education in the 21st Century*, 15 October, Bangi, Selangor, Malaysia.

Alessi, S.M. and Trollip, S.R. (2001). *Multimedia for learning: methods and development* (3rd Ed). Allyn & Bacon, Massachusetts.

Biehler and Snowman. (1997). *Psychology applied to teaching*. Houghton Mifflin Co.

Brown, L. and Lara, V. *Professional development module on collaborative learning*. http://texascollaborative.org/Collaborative_Learning_Module.htm?&lang=en_us&output=json [16 August 2012]

Centre for Instructional Technology and training, University of Florida. *Collaborative and cooperative learning*. http://www.citt.ufl.edu/toolbox/toolbox_collaborative.php?&lang=en_us&output=json [16 August 2012]

Chong, P.W. (2003). *Effects of cooperative learning on critical thinking skills and English language teaching efficacy belief of pre-service TESL teachers*, Ph.D thesis, Universiti Kebangsaan Malaysia, Bangi.

Cheah, L and Poon, I. (1999). Efficacy of cooperative learning among Malaysian secondary students. *Jurnal Pendidik dan Pendidikan*, *16, pp 29–37*.

Effandi Zakaria. (2003). *The effects of cooperative learning on students in a matriculation mathematics class*, Ph.D thesis, Universiti Kebangsaan Malaysia, Bangi.

Faizah, M. G. (1999). *Kesan Pembelajaran koperatif menggunakan alat ujian pencapaian dalam Matematik*, Projek Penyelidikan Sarjana Pendidikan, Universiti Kebangsaan Malaysia, Bangi.

Goodsell, A., Maher, M. and Tinto, V. (1992). *Collaborative learning: a sourcebook for higher Education*. National Centre on Postsecondary Teaching, Learning and Assessment, University Park, PA.

Ismail, S.B. and Rizan, T.N., *The effects of cooperative learning in enhancing writing performance*, http://www.ukm.my/solls09/Proceeding/PDF/Shafini.pdf [17 August 2012]

Johnson,D.W. and Johnson, R.T. (1994). *Learning together and alone : cooperative, competitive and individualistic learning* (4th Ed). Allyn & Bacon, Boston.

Johnson, D.W. and Johnson, R.T. (2004). *Assigning students in group*. CORWIN PRESS, California.

Johnson, D.W., Johnson, R.T. and Holubec, E.J., *Cooperative learning in the classroom*. Association for Supervision and Curriculum Development, Alexandria, VA 22314.

Kagan, S. (1994). *Cooperative learning*. Kagan Publishers, CA.

Lee, G.E. (1999). *Pembelajaran koperatif dan kesannya ke atas pencapaian kemahiran penyelesaian masalah matematik teras tingkatan 4 di sebuah sekolah di Daerah Kota Setar*. Kedah, Malaysia, Projek.

Mazlan, I. (2002). *Amalan pembelajaran koperatif oleh guru-guru dan kesan ke atas sikap pelajar terhadap matematik*. Projek Penyelidikan Sarjana Pendidikan, Universiti Kebangsaan Malaysia, Bangi.

Melor Yunus, Idris, F. and Ali, Z. (2001). Collaborative learning: every teacher's better half. *Proceedings of the International Conference on Teacher Education*, Shah Alam, Malaysia.

Mullis,V.S, Martin M.O., Gonzalez, E.J. and Chrostowski, S. J. (2004). *TIMSS 2003 International Mathematics Report*. TIMSS & PIRLS Internatinal Study Center, Lynch School of Education, Boston College.

Nagata, K. and Ronkowsk, S. (1998). *Collaborative learning: differences between collaborative and cooperative learning*. The Office of Instructional Consultation, University of California Santa Barbara.

Posamentier, A.S., Smith, B.S. and Stepelman,J. (2006). *Teaching secondary mathematics: techniques and enrichment units*, (7th Ed). Pearson Education, New Jersey, p. 6.

Pressel, B.E. (1992). *A perspective on the evolution of cooperative thinking*, In Davidson and Worksham (Ed), *Enhancing thinking through cooperative learning*. College Teachers Press, NY.

SEAMEO RECSAM. (1997). Cooperative learning and constructivism in science and Mathematics Education. *International Conference Proceeding, RECSAM*, Malaysia.

Siti Rahayah Ariffin. (1998). Pengajaran dan pembelajaran koperatif sains: satu pendekatan berkesan bagi Sekolah Bestari. *Prosiding Seminar Kebangsaan Isu-Isu Pendidikan Negara*.

Slavin, R.E. (1995). *Cooperative learning: theory, research and practice*, Prentice Hall, NJ.

Suhaida, A.K. (2000). *Perbangdingan pembelajaran koperatif dan tradisional terhadap prestasi, atribusi pencapaian, konsep kendiri akademik dan hubungan sosial dalam pendidikan perakaunan*, Tesis Ph.D, Universiti Putra Malaysia.

Subahan, T. M. M. (2007). Problem solving and human capital. *Proceedings of the Third International Conference on Research and Education in Mathematics,* Kuala Lumpur, Malaysia, Universiti Putra Malaysia Press, Serdang.

TIMSS. (2003). *Trends in International Mathematics and Science Study*, http://timss.bc.edu/timss2003/index.html.

TIMSS. (2007). *Trends in International Mathematics and Science Study*, http://timss.bc.edu/TIMSS2007/index.html.

Tribe, M. R. (1994). *An overview from higher education*. In Thorley, L. and Gregory, R. (Ed), *Using Groupbased Learning in Higher Education*. London: Kogan Page, 25-31.

Yee, C.T. (1995). *Kesan pembelajaran koperatif terhadap pencapaian matematik dari segi akademik dan kemahiran penyelesaian masalah di kalangan pelajar tingkatan empat di sebuah sekolah di Malaysia*, Tesis Sarjana, Universiti Sains Malaysia.

Zainun Ismaon, Z. (2003). *Kesan pembelajaran koperatif model STAD ke atas sikap dan persepsi murid tahun lima dalam mata pelajaran matematik KBSR*, Projek Sarjana Pendidikan, Universiti Kebangssan Malaysia.

Zakaria, E. and Yusuff, N. (2009). Attitudes and problem-solving skills in algebra among Malaysian matriculation college students. *European Journal of Social Sciences,* 8 (2), 232-245.

Zakaria, E. and Zanaton, I. (2007). Promoting cooperative learning in science and mathematics Education. *Eurasia Journal of Mathematics, Science and Technology Education, 96* (2), 112-116.

Zakaria, E., Chin, L.C., and Yosoff, D.M. (2010). The effects of cooperative learning on students' mathematics achievement and attitudes towards mathematics, *Journal of Social Science,* 6 (2), 272- 275.

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