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A Study on Learning Pre-Algebra Using Interactive Multimedia Courseware Within Collaborative Learning Set-Up and E-Mail Interactions

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Abstract – Many students at diploma level are weak in mathematics even after spending eleven years in Malaysian education system. However, throughout the world there are research studies been done with mixed results using technology and collaborative learning. The objective of this paper is to analyze the effect of learning pre-algebra using interactive courseware with collaborative learning by using STAD set ups with interactive courseware using e-mail facilities during team discussion only. Quasi experimental type research was used. The gain score (differences between post and pre test) between the two equivalent groups were obtained. Diploma Information Technology first year students in two different intake years 2009 and 2010 in UTHM were employed. 't-test' results revealed the second group using e-mail is statistically significantly inferior to the group using purely interactive multimedia courseware CDiCL only with STAD team discussion. On average participants experienced higher gain scores in the first group (Mean = 3.28, SE=0.433), than participants in the second group (M=0.77, SE=0.354). This difference was statistically significant (t (74) = 4.51, $p<0.05$); however, it did show a medium effect size of r = 0.45. Some clinical interviews and audio-video recordings were taken to support that teams prefer using conventional collaborative learning method with more group discussions rather than e-mails and facebook in solving problem.

Keywords: mathematics information technology, algebra, CDiCL, facebook.

Introduction

Many students at certificate and diploma level are weak in mathematics even after spending eleven years in Malaysian education system. Computing courses in Malaysian tertiary institutions of higher learning take mathematics as the core subject where tutorials are sometimes spent as remedial. However, there are research being done using technology and collaborative learning with mixed results (Khalid *et al*., 2010a; Mays, 2005). According to a Tracer Study Polytechnic MOHE Malaysia in 2006, IT graduates were employed mainly in services industries where decision makings has to be made fast in the Kuala Lumpur stock exchange for example, was the most valuable asset sought for by prospective employers. To develop this a curriculum of mathematics in IT era was designed. Anecdotally, in year 2000 FTMM (Fakulti Teknologi Maklumat dan Multimedia) was operating as a department called JTMM under Faculty Engineering Technology, in KUiTTHO (Kolej Universiti Teknologi Tun Hussein Onn). As a result Diploma Mathematics IT 1 adopted UTM's Diploma Computer Science syllabus and curriculum. Discrete Mathematics topics and tutorial (pen and paper) was the order since most of the mathematics lecturers graduated from UTM. In 2004 KUiTTHO was officially upgraded into the 17th full fledged public university in Malaysia called UTHM and JTMM became a faculty called FTMM which introduced Mathematics IT 1 and Mathematics IT 2 for the first year diploma students with all the mathematics topics still intact plus the introduction of laboratory activities (Khalid *et al*., 2006). The objective was to let the students see mathematics applications in information technology. License packages like SPSS and Matlab were incorporated into the syllabus since it took more rigorous statistical approach with probability distributions, permutations and hypothesis testing. Problem Based Learning (PBL) was tried in UTHM using Republic Polytechnic Singapore experience as the yardstick.

Current issues

At diploma level many lecturers from the local universities found that mathematics was not rigorously understood even though the students who successfully entered the university programs with high grade score in SPM (equivalent to GCSE 'O' levels). For example statistics from Kelantan State Education Department (2003 – 2006) revealed the average rate of passes SPM Mathematics was 75% only. This means that 25% failed mathematics at SPM level. In spite of 75% passes, some of them were found to be struggling in mathematics, statistics and quantitative methods once they entered Diploma and degree studies especially on topics involving algebra (Khalid, 1990). Something must be done some how quickly since *e-learning* has become the in-things of today. More over algebra is the gate to many advance mathematical topics in the universities.

Many researches were done about the above problem with mixed results (Healy, 1998; Heid, 2002; Zain *et al*., 2006). In Malaysia, many young teachers complained that they could not deliver mathematics concepts very well in English which started 2003 during PPSMI. (Tan, 2007). PPSMI was introduced at Primary Year 1, Form 1 and Lower 6

at the public schools. It was found that many senior teachers who were trained in English medium schools took administrative duties while the young teachers (aged 45 below) who had learnt and fully trained in mathematics in Malaysian language beginning 1979. Hassan (2008) studied on learners and teachers style using computers. He correctly pinpointed one thing - both parties have different strength and weaknesses as far as learning and teaching styles which did not match for the optimum benefit for the students' side.

During PPSMI, in order to hasten many ideas, the Ministry introduced critical allowance schemes, computer notebooks for mathematics and science teachers and many kind of ICT courses were offered during the school holidays. At the earlier stages when this scheme was introduced many teachers were happy. But soon many reports came where computers were stolen from schools and some teachers misused the computers. Besides, many parents perceived that tuition in mathematics was more effective than schools. This is because young teachers are inexperienced (Puteh, 2003). Currently, all teachers are paying so much attention to examination results. The whole country was so obsessed with how many 'As' each school and candidate can get every time the examination result was announced . From this result the school is categorized into cluster schools and these schools are going to be treated differently from the ministry in terms of annual 'budget', staff recruitment and other incentives. One of them is they can hire their own set of teachers (PTA Talk in KISAS) and the school enjoyed better treatment. Unknowingly, sometimes creative teachers are temporarily sidelined. A creative teacher is defined as someone who is braved enough to teach differently from the syllabus (Schifter and Fosnot, 1993). Once the school is very focused to excel only in the public examination it was found the standard of questions posed by the teachers were steroetyped. What is asked are mostly public examination questions and nothing else. Without critical and challenging questions it is hard to produce holistic learning that produces first class engineers, scientists and professionals (Idris, 2006). Noraini claimed that students who were taught mathematics in visual mode understood mathematics better. But Healy (1998) disagreed when many visual aided students understood mathematics from the surface level only and this was insufficient for higher college mathematics.

One of the main features of cluster and smart schools is the employment of ICT in teaching mathematics and sciences. Advantages of computer-aided-instruction are increased student engagement and motivation, providing students with a greater level of individualized instruction (Barrow *et al*., 2008). Since mathematics is synonym to drilling and practice, ICT is looked as the rescue to teaching problems especially in remedial work. According to MOE INTEL 2007 report, USA experienced 20 – 30 percent remedial classes at high colleges and first year degree programs. When Malaysia is facing with remedial classes in polytechnics and colleges communities MOHE, it seems that USA, a developed country, is experiencing that too (Barrow *et al*., 2008).

Drilling and practicing is taken quite well at schools because item analysis by Mun and Tiong (2005) found that 50% of the PMR and UPSR questions set 2003 – 2006 was categorically put as simple, 30% are medium difficulty and 20% are challenging. Many 'naughty' teachers know that by drilling their students at easy and middle type of questions would suffice their students to pass in any public exam. As a result many students are not exposed at all to harder critical thinking skills since many teachers rushed with the syllabus. Once they are at the university the students look so lost. They cannot help themselves with internet to find important facts in mathematics. What was seen they used ICT not for studying related subjects but reading gossips.

Understanding the above issue FTMM was braved to introduce Mathematics IT syllabus for two semesters in Diploma Information Technology (DIT) Year 1. Assessment of this subject is 60: 40 favouring coursework than final examination. This style of evaluation and assessment is identical to polytechnic education assessment system in this country since the students in DIT programs were graduates from the polytechnics and college community MOHE. Smart school came with ICT technology. Zain *et al.* (2006) complained that not all school heads know how to instruct the teachers in using CD-ROMS supplied by Technology Education Department, MOE. These so called principals always focus on exam results while CD-ROM put forward many ideas that can come later. So it seems there is lacking in using teaching aids like CD at schools. MOE Project Report (2007) suggested the schools to introduce ICT into mathematics and science subjects beginning primary and secondary schools in order to create talented pool of engineers, scientists and entrepreneurs but they have some problems including time tabling in schools and getting smoother accessibility towards teachers in running ICT courses during school holidays. They suggested group blocking on certain specific day from the time table in order to reduce technical problem carrying ICT tools into classrooms. But the success of smart schools depends heavily on teachers' attitude. Attitude, motivation are all related in working successfully among teams in society (Shane and Von Glinov, 2008). Here Shane and Von Glinov did not encourage any team to appoint a leader who has limited ability in a specified skill. Now Facebook is getting more popular not only among youngsters in social networking but also among teachers. They shared messages, pictures, video clips and they can use it for studying purposes. *e* -mails are popular too. Now how can we implement mathematics education using ICT in Malaysia. Thus a curriculum and syllabus for Mathematics IT came into UTHM. The objectives of this study is to analyze the effect of learning pre-algebra using interactive courseware with collaborative learning set up against a group that use mainly e-mails and facebook and determine whether e-mails and facebook help mathematics learning.

Materials and Methods

The structure of the experiment is shown in Figure 1. This structure was agreed since calculus came during Week 7 and Week 8 of 1DIT Mathematics I.T. syllabus. Between Week 3 to Week 6 they were exposed to more algebra, Discrete Mathematics and Series. CDiCL (Compact Disk interactive Collaborative Learning) used ADDIE methodology under multimedia interactive courseware development. It was tested in Polytechnic Kota Bharu, Kelantan and a secondary school in Pasir Mas, Kelantan in 2006. (Khalid, 2010). The content of the CD has more than 10 topics under pre-algebra, factorization and simplification. It was recommended that CDiCL would be more effective if it was used with lower size team of 3. Managing the class was much easier.

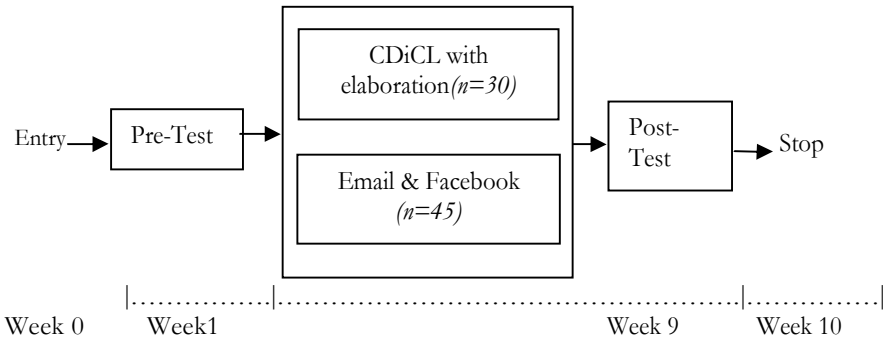

Figure 1. Basic Structure of the experimentation

Results and Discussion

Quasi-experimental design was employed where it was not possible to randomize any student to participate. Group I (Control using CDiCL and CL only) n=30; 22 girls 8 boys. The students were academically equivalent as their entry was controlled by MOHE.

Learning processes

First week, they were explained about the study to compare effectiveness studying mathematics IT using CD-ROM and CL against another group learning mathematics using *e*-mail only). They were asked to sit for PRE-TEST and after ninth week the POST TEST was conducted. Both tests had similar questions. Marks from pre and post test are taken as coursework marks in their diploma program. They are divided into two different groups size 18 and 12 of them. The first group came at 0800 am and the second group came at 0900am. They were required to learn pre-algebra skills using CD-ROM called CDiCL which has 20 different modules. Each session they must cover at least 2 – 3 modules while solving word problem in between. This was to maintain focus all along the session. The instructor selected the team using math results from SPM. Each team has 5 members and they solved it collaboratively using STAD (Student Team Assessment Division) set up which has a leader, assistant leader, reporter, manager and time keeper. At the end of each session they must submit a report. Computing time is about 20 – 40 minutes *only. The rest of the session is used by the instructor (the first author) to explain recommended solution during the CL work.

Group II (using e-mails and facebook) - Experimented group (n=45) 30 girls 15 boys.First week, they were explained about the study to compare effectiveness studying Diploma Mathematics IT using e-mails and facebook against learning mathematics using CDiCL. They were asked to sit for PRE-TEST and after ninth week POST TEST was conducted. Marks from pre and post test were taken as coursework marks in their diploma program. Both tests have identical questions. They were divided into two different groups size 25 and 20 of them. The first group came at 0800 am and the second group came at 0900 am beginning 2nd week to the 9th week. They were required to learn pre-algebra skills using CDiCL that was already uploaded on the server. Each session they must cover at least 2 – 3 modules while solving word problem in between. This was to maintain their focus. During the learning process they were allowed *e*-mail facilities and facebook within 20 – 40 minutes only. To enhance e-mailing work half of each team sat in different room. The team members was selected using results from SPM (Sijil Pelajaran Malaysia). Each team has 5 members. However to reduce face to face discussion between peers in any team, few members of any team must come at 0900 am session but the team leader must come at 0800 am session. To prove their work, each team must submit a report to the lecturer. This was easily done by looking at the lecturers' weekly *e*-mail activities. Computing time is about 20 – 40 minutes * per session. The rest of the time was used by the lecturer (the first author) to explain mathematics solutions during their e-mail and Facebook encounters.

Learning outcome

The students obtained all their marked pre and post test after the 9th week with full elaboration by the first author. The recommended answers were put on paper for students' notes.

Results

The result was analysed using SPSS version 16.0. Descriptive and some basic statistics t-test was used in analyzing the effectiveness of these two groups. The first author was teaching both sets of students 2008 and 2009. This is to

reduce biasness and any discrepancies (extraneous variables) in the teaching values. The first author has more than 20 years experience teaching mathematics at diploma level (Kota Bharu Polytechnic and UTHM). In order to explain the result, we are going to use Table 1 as a guide.

Table 1. Framework for explaining the outcomes

Input	**Process**	**Output**
Teaching method (the INDEPENDENT VARIABLE)	Elaborated explanations, quality and quantity of explanations from CDiCL quality of interactions – Peer-to-peer; student-lecturer from Collaborative Learning Perceptions of peers and lecturers; E-mails, facebooks	Quantity of learning –score from test - DEPENDENT VARIABLE – gain score.

In this section two types of results are shown.

Quantitative and qualitative results

Quantitative results

Descriptive statistics in terms of the Gain score (difference between post and pre test score) is shown in Table 2. Here the control group mean is three times than the experimental group even though standard deviation between them is almost equal. This implies that they are equivalent in ability since all entries into UTHM were processed by MOHE in Kuala Lumpur. Since two groups of students were tested, an independent't-test' statistics was employed. Table 3 has the details.

Table 2. Descriptive statistics of the two different participating groups

Method	Mean	σ	St. Error
Group 1(control) CDiCL n=30	3.28	2.372	0.433
Group 2(Facebook and e-mails) n=45	0.77	2.314	0.345

Table 3. Results of Independent Equal Variance t-test

			Levene's Test for equality of variance		t-test for equality of Means				
Gain Score			F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std. Error Difference
	Equal variances assumed	Group1	1.078	0.303	4.51	74	.0031	2.51	0.554
	Equal variances not assumed	Group2	-	-	4.67	68.27	.002	2.51	0.554

From Table 3, Levene's test produced non-significant (i.e. p >0.05) then the null hypothesis was accepted that the difference between the variance is zero - which implies the variance are roughly the same and the assumption is tenable. For these data, Levene's test is non-significant so we read the test statistics in the row labeled Equal Variance assumed. This again implies homogeneity of variances is met by looking at the mean difference of 2.51 and the standard error difference of 0.554. In the case of 2-tailed test of $\boldsymbol{p}$ equals to 0.0031 which is smaller than 0.05, we could conclude there was a significant difference between these two groups of 1DIT students in UTHM. In terms of the experiment we can infer that students are not equally excited to use a courseware CDiCL delivered through the server with some collaborative learning against another group of DIT students using e-mails and Facebook. Calculating the effect size, a score of 0.45 was obtained which is substantial (Field, 2000).

Qualitative results

While doing the experiments, the following data were obtained through clinical interviews and audio video recordings (Table 4). This is to triangulate the above quantitative findings. What could be gained from this qualitative data was firstly many students enjoyed using e-mails and facebook since this was the trend among

youngsters. However their mood could easily change if they faced difficulties in getting feedback from peers and handling problems to use symbols and notations in e-mail and facebook modes.

Table 4. Advantages and disadvantages of methods

Items and characteristics	Advantages	Disadvantages
CD-ROM known as CDiCL	Easy to understand and control	Boring / not the state of the art
Collaborative learning for they are sitting in pairs	Peer to peer discussion on word problem. More members talking in malay. The mathematics concepts are relayed in malay by the instructor too.	The worthiness of their discussion depends on the readiness of the members in each team i.e., the discussion is more fruitful and effective in solving more word problems.
e-mails only; FB; they sit by themselves alone	It looked more conducive, the state of the art.	Interesting but lonely. The student cannot walk all over the places to discuss. They just e-mail their problems and suggested solution. Problem symbols and notations (noted).
e-mail	They can write anything they like but malay was more used in their e-mails and this created nice conditions.	They cannot talk as freely as what they used to do all this time. They can only emails or Facebook. New experience.
Facebook	They looked happier. They can see their friends faces.	They think more in giving opinions and criticisms.

Discussion

In this study 75 Diploma Information Technology from UTHM students took part and they were put into two different groups. One studied in 2008/09 session and the other one 2009/10 session. The first group used CDiCL courseware with collaborative learning set up while the second group practiced electronic mails and Facebook to learn algebra topics. The first author was the only mathematics instructor among the two groups. From the result section, e-mail group did not do so well as compared to CDiCL and collaborative learning group. The average gain score obtained from the e-mail group and Facebook is lower than the old collaborative learning group using CDiCL. This implies that stability among group members of 3 is important to be achieved as face to face discussion is more fruitful than e-mails and facebook during mathematics learning. And this concurs with Zain *et al.* (2006), Tan (2007), Hassan (2008) and Shane and Glinov (2008). May be the members lost their focus once they got facebook as the facility to learn since the students suddenly changed their mood to study using online computers facing symbol problems and this concurs with MOE INTEL 2007 report. Word problem solving exercises could be more effective in malay language (Khalid, 2010b) and this was so not well demonstrated by the second group using *e*-mails and facebook.

The contribution of this paper is that we could see students can do higher mathematics if they were trained to experience new things than their normal classrooms i.e., conventional encounters. This came with some creativity and innovation from lecturers' sides i.e., trying collaborative learning method besides the use of teaching aid – CdiCL as a start. Their work in the computer laboratory must be guided with some sort of 'word problem' solving tasks within specified time per session in order for them to learn higher mathematics using youtube in future. The experiment in FTMM UTHM DIT Year 1 was differently done than schools that participated in MOE INTEL 2007 program where in UTHM more 'solid questions' were prepared as the main guide in the computer laboratory work. In MOE Intel report 2007 some students complained they were more advanced than the teachers in getting correct web sites for learning purposes. The only limitation was this study had used UTHM diploma students only as sample and they were still new to this style of learning in the first semester. Perhaps if this approach is tried in degree programs with bigger size of samples running across different faculties in UTHM and/or in different universities, the result could be more applicable for the usage of future teaching and learning strategies. Another obstacle was to understand algebra the sample had used English and Malay when mathematics algebra itself has its own language and concepts as well. From interview, few students complained – their understanding in algebra did not match with their marks at all and they did face symbol problems in Facebook and e-mail interactions. In sum, these students had gained few learning and teachings skills from this study to be used in the coming semesters.

Conclusion

This study had used quasi-experimental method with two batches of Diploma IT students 2008/09 and 2009/10 in UTHM (N=75). It presented a pedagogical approach i.e., using computers in learning mathematics in Collaborative Learning set-up as compared to learning using e-mails and facebook. The former group did better from social interaction between teams as found in their gain scores (difference in marks between Post and Pre Tests) as compared to the latter. New learning and teaching experience were obtained among the participants and symbols and notation problems were faced during e-mails and Facebook interactions.

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References

Barrow, L., Debraggio, E., and Rouse, C.E. (2008). Failing in mathematics.(url address: http://www.voxeu.org/index.php?q=node/2722) accessed on 26 July 2011.

Field, A. (2000). Discovering Statistics using SPSS. 2nd Ed. London: Sage

Healy, J.M. (1998). Failure to connect: How computers affect our children's minds – for better and worse. USA: Simon and Schuster.

Heid, M.K. (2002). Computer algebra systems in secondary mathematics classes: The Time To Act is Now!". Mathematics Teacher, 95(9): 662-667

Hassan, R. (2008). How do learners respond to computer Based learning material which has been designed to suit their particular learning style. Ph.D thesis. Warwick University, UK. (Unpublished)

Idris, N. (2006). Teaching and learning of mathematics. Making sense and developing cognitive abilities. Utusan Publications and Distributors Sdn Bhd, Kuala Lumpur. (Unpublished).

Mays, H. (2005). Using the results of diagnostically testing to promote mathematical pedagogical knowkedge. Teacher Education: local and global. Australian Teacher Education Association 33rd Annual Conference proceedings., pp 310-316, ATEA, Australia.

MOE Intel Project Report. (2007). School adoption project phase 1. Ministry of Education Malaysia and Intel Malaysia. 1st edition. Kuala Lumpur: Educational Technology Division, MOE , and Intel Malaysia. ISBN 978-983-3244-87-4.

Khalid, M.S,, Hassan, H., Arbaiy, N., Afip, Z.A., and Abdullah, N.A. (2006). Statistical mathematics – laboratory activities. Teaching module. Parit Raja: UTHM Publication.

Khalid, M.S., Alias, M., Razally, W., Yamin, S., and Herawan, T. (2010a). The effect of using an interactive multimedia courseware within a collaborative learning environment on learning pre-algebra concepts. Procedia Social & Behavioural Sciences, 8: 571-579.

Khalid, M.S, K. (2010b). A study using interactive multimedia courseware in learning pre-algebra among polytechnic students in Malaysia. PhD thesis UTHM, Parit Raja. (Unpublished).

Mun, C., and Tiong, O.C. (2005). Siri Teks Referens SPM 4&5. Pearson Longman, Petaling Jaya.

Field, A .(2000). Discovering statistics using SPSS for windows (2nd Edition). Sage, London.

Healy, J.M. (1998). Failure to connect: How computers affect our children's minds – for better and worse. Simon and Schuster, USA.

Pusat Perkembangan Kurikulum (2001). Kemahiran Berfikir dalam Pengajaran dan Pembelajaran. Kuala Lumpur: Kementerian Pendidikan Malaysia.

Puteh, M. (2003). Factors associated with mathematics anxiety. UPSI, Tanjung Malim.

Schifter, D., and Fosnot, C. T. (1993). Reconstructing mathematics education. Stories of Teachers Meeting. The Challenge of Reform. Teachers College Press, New York.

Shane, M., and Glinov, V. (2008). Organization behavior. 4th Ed. Mc Graw, Boston.

Tan, M. (2007). Teaching mathematics and science in English in Malaysian Schools: Profiles of Teacher Learning within the context of educational reform. Proceedings of COSMED 2nd International Conference Math and Science Education. Penang: Nov 2007: 142 – 151.

Tracer Study. (2006). Projek kajian graduan politeknik Kementerian Pendidikan Malaysia bagi tahun 2003 – 2005 Accessed.ttp://www.politeknik.edu.my/WebSept07/PENERBITAN/TRACER_STUDY_2006/laporan_final_2006.pdf on 5 May 2009

Zain, M.Z.M., Majid, O., Luan, W.S., Fong, S.F., Atan, H., and Idrus, R.M. (2006). Computers in Malaysian smart school: The changing of technologies and mindsets. Malaysian Journal of Educational Technology, 6(2): 61-70.