Advances in Social Science, Education and Humanities Research (ASSEHR), volume 304
4th ASEAN Conference on Psychology, Counselling, and Humanities (ACPCH 2018)

The Effectiveness of Scratch in Collaborative Learning on Higher-Order Thinking Skills in Programming Subject Among Year-Six Students

Norizwan Ideris
School of Educational Studies
UniversitiSains Malaysia
norizwan82@gmail.com

Siti Mastura Baharudin
School of Educational Studies
UniversitiSains Malaysia
sitimastura@usm.my

Norhasyimah Hamzah
Faculty of Technical and Vocational Education
UniversitiTun Hussein Onn Malaysia
hasyimah@uthm.edu.my

Abstract: *This study aims to identify the effectiveness of the use of the Scratch software as a teaching aid in collaborative learning and its effectiveness on harnessing the ghigher-order thinking skills (HOTS) among year-six students undertaking a programming subject. The objectives of the study are to identify students' acceptance of using Scratch as teaching aid and to identify their level of HOTS after using the software. A quasi-experimental study was designed to consist of an experimental group and a control group. Altogether, 60 year-six students from the district of SeberangPeraiwere involved in this research. Quantitative instruments were used to identify the students' level of HOTS and their acceptance of using Scratch as teaching aid. The experimental group's learning activities involved the use of computer and Scratch,whereas the control group were involved in an unplugged activity that did not require the use of computers in their learning activities. Results for questionnaire score showed that students' acceptance of theuse of Scratch as a teaching aid was high (M=3.76, SD = 0.81), thus indicating that they agreed the use of Scratch is easy and able to facilitate their learning about programming. Results of the t test analysis on the students' pre- and post-tests scores showed significant improvements in their higher order thinking skills (t = 2.79, P < 0.05).In conclusion, the students' favor the use of Scratch as a teaching aid for a programming subject, particularly in acollaborative learning environment, because the utilization managed to improve their scores in tests and higher-order thinking skills.*

Keywords: Higher order thinking skills, programming language, collaborative learning

Introduction

In parallel with the developments in science and technology, the education fieldhas evolved along with the transformation of information technology and communication (ICT). The use of ICT-based teaching aids in the implementation and delivery of teaching and learning (TnL) in classroom has given some positive impact among students and teachers.According to Moura and Hattum-Janssen (2011), the use of software as teaching aidsin classroom learning can enhance student's achievement and interest in a subject.

One of the new components implemented in the Primary School Standard Curriculum (KSSR) is the high-order thinking skills.To achieve success, it is imperative that a student has analytical thinking skills, an ability to synthesise, as well as high-order thinking skills (HOTS)(Laskhmi& John, 2008). In attaining such skills, students need to change their way of thinking from "ordinary" to "extraordinary." Besides, in implementing the twenty-first century learning, it is crucial that students have critical and creative thinking skills that are parallel with HOTS. This need is in line with the research conducted by Wan Ismail, Hamzah and Lubis(2016),who state that one of the most emphasised skills in the twenty-first century teaching isthinking skill.

Teaching and learning activities (TnL) will be more interesting if combined with the use of computer software that is relevant to the teaching topic (Kay et. al., 2000). The *Scratch* software, in particular, is a software capable of providing a distinctive meaning especially in the construction of a desired programming project (Mitchel et. al., 2009). The software can also help students in translating something that can have a positive impact in building their self-confidence in the form of programming project construction. The value-added classroom environment with the creation of the latest technology is able to give a positive impact on the acquisition of students in HOTS (Michael et. al., 2014). This notion suggests that the presence of the latest creation of technology will encourage the increment of students' ideas hence their understanding of the HOTS during a TnL activity.

In implementing teaching and learning activities (TnL) in classroom, teaching aids can help teachers and students in achieving the expected learning objectives. In delivering information to students on the subject of teaching, a teaching aid can help students obtain information more clearly and systematically (NorhidayahMahadi, 2016). This shows thatteaching aid plays an important role in enhancing the understanding of a student in a topic of teaching. In fact, the presence of teaching aids in the classroom is an effective way of improving student-centered learning techniques and further enhancing the student's understanding of what being taught (Kamarul et. al., 2011).As attested by the findings of Gress and Hadwin (2010), the level of student's ability can be stimulated and the student's interest can continue to be cultivated using appropriate teaching aids.

In collaborative learning, higher-order thinking skills can enhance the creative and critical thinking of students in carrying out teaching and learning activities within a group. This finding is in line with the research conducted by Lee (2010)who found that a pedagogical activity that implements collaborative elements is capable of enhancing students' soft skills and HOTS. In addition, collaborative learning also involves online discussions that can further generate students' understanding of HOTS. This notion is supported byNurbihaet. al.,(2014), who found that collaborative learning online will garner deep discussion and thought hence enables knowledge to be built. This finding suggests that online collaborative discussions will generate students' HOTS and enable them to think further and build more in-depth knowledge.

Based on the instruction of the Ministry of Education (MOE), the school should make it compulsory for the Information Technology and Communication subject to be taught at the beginning of 2014 at all primary schools within Malaysia. This shows that the Ministry of Education Malaysia intends to produce students who are exposed with the latest information on information technology and communication, in line with the rapidly developing technology.However, many software used in the market today are using more complex software, such as Programming C, C ++, Java Script etc. This is supported by Moura and Hattum-Janssen (2011), who state that in implementing common TnL methods in the classroom, C ++ programming subject learning is not easy to implement. Most of the programming software used in the market is not suitable for school students at the year-6 level because at this age, their development of thoughts is at a low level.

Students' thinking skills differ from each other. As a result, teachers will face and deal with students with varying degrees of thinking (Mohamed Jamal, 2016). In addition, students at the school level are less skilled at using HOTS in carrying out TnL activities in the classroom. This notion is clearly supported by Yee Mei Heong (2015) contends that in using thinking skills in the TnL process and in everyday life, studentsdo not have or lack of clear guidelines. This understanding indicates that that students still require something that can help them in changing their thoughts towards HOTS. Hence, of the use ofinformation technology and communication can facilitate the generation of students'HOTS thinking.

The creation of the latest teaching technology tools has the potential to impact the delivery of knowledge and skills in order to improve the student TnL process . TnL activity in classroom should have diversifiedteaching aids resources. Old methods such as the use of "chalk and talk"are no longer relevant now. As stated by Hayazi (2008), the method of "chalk and talk" teaching activities would bore hence demotivate students. Khoo Yin Yin (2008) stated that students' attention in classroom will be reduced with the use of the whiteboard methods because such method causes them to feel less interested with classroom activities. This finding indicates how the "chalk and talk" method might negatively affect thereaction of students in the classroom.

Given the above points, it is timely that a study be conducted to uncover teaching aids that can generateHOTS thinking among students to be used to enable students to respond actively and positively when TnL is conducted in the classroom. In achieving a particular objective of TnL, students can adopt collaborative learning to helpone another and interact with each other (Gress andHadwin, 2010). Collaborative learning thus will be more interesting if every member or student engages each other's thoughts and physical energy in order to achieve the desired objectives. The problems that occur at the primary level, however, are that students prefer to carry out TnL activities alone rather than in groups. As mentioned byKhoo Yin Yin (2008), studentswere unprepared and not interested before group discussions and they are also influenced by an inappropriate learning practice method. Given these points, using the *Scratch* software in collaborative activities will help to increase the students' confidence and achievement in classroom. Therefore, this study sought answers to the following research questions:What is the state of the students' acceptance of the *Scratch* software as a teaching aid and what is their level of high-order thinking skills (HOTS) when using the *Scratch* teaching aid?

Method

The research was designed as a quasi-experimental research involving an experimental group and a control group, and both groups were given a pre test and a post test. The pre testwas administered to both groups in order todetermine the students' prior knowledge on the*Scratch* software. After having completed the pre test, the experimental groupparticularly was asked to learn how to use the*Scratch* programming software while the control group was asked to learn how to use an"unplugged activity" method. After the two groups underwent the prescribed teachings, a post test was administered tothe students of both groups in order to assess their achievements.

Year-six students were chosen as the sample of the study because the Malaysian year-six syllabus includes learning how to use the *Scratch* programming software.The population of year-six students in two schools within the NibongTebal Zone, Penang, consists of 106 students. However, following the recommendations by Morgan (1970), only 75 students wer selected as samples for the study. A total of 37 students were selected as members of the experimental group. The remaining 38 students were selected as members of the control group.

Research Instruments.A questionnaire was determined to be the instrument of data collection because the instrument is not influenced by the researcher hence is able to increase the accuracy of responses (Zurina, 2016). The questionnaire consists of the following three sections: i. Part A: Background of Respondent. ii. Part B: Student's Interest on *Scratch* Software as a Teaching Aid. iii. Part C: High-Order Thinking Skills (HOTS) by using the Scratch Teaching Aid.

Pre and Post Test: A pretest was administered to the students in both groups before the implementation of the *Scratch* programming software session. In this test, the students were required to answer sixsix questionson the topic "Programming and Testing of Scratch Software." These questions were constructed on the basis of the six levels of HOTS as proposed by the Bloom Taxonomy, namely recalling, understanding, applying, analyzing, evaluating, and creating. The items of these questions are based on the Curriculum and Assessment Standard Document, Information Technology Communication, Year-6 Primary School issued by the Ministry of Education Malaysia.

Data Collection.A permission to conduct the researchmust be sought so that the collected data and information are from a valid source. To conduct the research, the researchers first filled out a special form from the Planning and Education Policy Research Division (EPRD), Ministry of Education Malaysia (MOE). Upon approval from the EPRD, letters issued by the EPRD will be sent to the Communications Division of the Department of State Education (JPN). This measure served to inform school administrators about the need to involve the students in the study.

After that, the pre testwas conducted, involving two groups of students: the experimental group and the control group. Each group had to undergo two different teaching methods; the experimental group usedthe *Scratch*programming software while the control group use the"unplugged activity" learning method. Each of these two groups consisted of small groups of three students each. This measure served to ensure that the two experimental groups and the control group carry out the TnL activities collaboratively. The purpose of the research was to see how collaborative learning in TnL activities using *Scratch*affected thestudents interest, achievement, and HOTS. After the teaching session, the two groups undertook a post test. In the last stage, the respondents were asked to fill a questionnaire after being briefed about the study by the researcher.

Result

Research Finding 1: Students' Acceptance Levels towards *Scratch* as Teaching Aid

Table 1. Analysis of Students'Acceptance Scores with the Use of 'Scratch' as a Teaching Aid

	N	Mean	Minimum	Maximum	Standard Deviation
Acceptance to 'Scratch'	75	3.76	3.52	3.96	.28

Table 1 showed the mean value of students' acceptance of the *Scratch* programming software as a learning aid.

As indicated, the overall mean of the students' acceptance of the *Scratch* programming software as a teaching aid was 3.76, thus indicating that their acceptance is high.

Research Finding 2: Students' High-Order Thinking Skills (HOTS) Level with the use of Scratch Software

Table 2:Mean Scores for Pre Test and Post Test of High-Level Thinking Skills (HOTS)

Group	Mean			Standard Deviation		Std error of mean	
	Pre	Post	Difference	Pre	Post	Pre	Post
Treatment (N=37)	11.40	31.50	+ 20.1	13.17	14.69	2.41	2.68
Control (N=38)	11.90	21.17	+ 9.27	10.25	12.88	1.87	2.36

Table 2 showed the differences in terms of the theHigh Order Thinking Skills (HOTS) between the control group and the treatment group in the pre test and post test. The treatment group showed a significant improvement in terms of scores (M = 20.1, SD = 1.52) while the control group showed lower improvement (M = 9.27, SD = 2.63).

The independent sample *t*test was used to identify the significant differences between the mean score of the highorder thinking skills (HOTS)in treatment groups with control groups. The t test shows a significant result(t[58] = 2.896, p<.05) thus indicating that the null HOTS is significantly different between the treatment groups and control group. Conclusions can be made based on the results of the null hypothesis that there is a significant difference between the level of the high-order thinking skills (HOTS) and the use of Scratch programming software as a teaching aid.

Discussion and Conclusion

In the pre test and post test, the students of the experimental group demonstrated a high level of high-orderthinking skills (HOTS). A significant gap was also noted between the mean score of the students in the control groupand that obtained from the post test of the students of the experimentalgroup. This findingimpliesa positive improvement in the students' score with the use

of *Scratch*instead of with the unplugged activity. The finding appears to be consistent with Nuutila, Torma and Malmi (2005) who found that a visual programming language can increase students' performance in teaching and learning activities in classroom. This shows that the use programming in TnL activities 'can improve students' understanding of what being taught in a particular subject. The result of the present study is also in line with the finding in Melisa (2015), who found that the use of *Scratch Jr* software had increased the scores among kindergarten students.

In addition to using the pre test and post test questions for quering on HOTS, the findings indicate that the students' levels of HOTS were particularlyhigh, which is consistent with the findings in Melisa et. al., (2015). Melisa et al. found that using the *Scratch* software through project-based activities enabled studentsto translate their creative ideas byconstructing programming projects. In another study, Rafiza et al. (2015) found that students were able to write well and improved their critical thinking after using the programming software. This finding shows that a programming software can increase students' HOTS in learning. Correspondingly, Hager et. al., (2003)found that C, C ++ or Java programming language can affect the critical thinking (HOTS) of a programmer. Although the study adopted different programming software,the method used in developing the programming language was similar.

In terms of the students' acceptancein using the *Scratch* software as a teaching aid, the study found that their acceptancewas at the average high level. This finding is consistent with that ofQuah(2016), who found that the use of online software can attract students' attention and interest in English subjects. The finding of the present studyis also in line with the research conducted by NurHidayah (2016), who found that using multimedia software in learning is able to attract students in classroom and that learning ubysing this multimedia is funto them. Correspondingly, Ting Suh Ping (2009) found that the use of computer software and video clips managed to help raise students'interest in learning science subjects. In Danijel et al. (2009), they found that computer usage among year-sixstudents in a school in Philippineshad attracted them to learnthe subjects taught by their teachers and further improved their scores. The finding also indicates that the students agreedto the simplicity of the use of *Scratch* programming software and that the use of the softwarecan facilitate their completing their work. A small number of students, however,were the least certain that the use of the software is a positive idea.

References

Bahagian Pembangunan Kurikulum, KementerianPendidikan Malaysia (2014). *Dokumen standard kandungan & pentaksiran kssr :teknologi maklumat & komunikasi tahun 6.* Putrajaya: Ministry of Education, Malaysia.

Bahagian Pembangunan Kurikulum, KementerianPendidikan Malaysia (2014). *Kemahiran berfikir aras tinggi (kbat) aplikasisekolah.* Putrajaya: Ministry of Education, Malaysia.

Nuutila, E., Torma, S. &Malmi, L. (2005) PBL and computer programming - the seven steps method with adaptations.*Computer Science Education*.15 (2), 123-142.

Danijel, R.,Tihomir, O., &Alen, L. (2009). Verificator: educational tool for learning programming. *Informatics in Education,Vol. 8, No. 2, 261–280.*

Gress, C. L. Z., &Hadwin, A. F. (2010). Advancing educational research on collaboration through the use of gStudy computer-supported collaborative learning (CSCL) tools: Introduction to special issue. *Computers in Human Behavior, 26*, 785-786.

Hager, P., Sleet, R., Logan, P. & Hooper, M. (2003).Teaching critical thinking in undergraduate science courses.*Science and Education,* 12(3), 303-313.

HayaziMohdYasin.(2008). Penggunaan alat bantu mengajar (abm) di kalangan guru-guru teknikal di sekolah menengah teknik. Daerah Johor Bahru, Johor. Masters Degree Thesis,UniversitiTeknologi Malaysia.

Kay, J., Barg, M., Fekete, A., Greening, T., Hollands, O., Kingston, J.H., & Crawford, K. (2000).Problem-based learning for foundation computer science courses.*Computer Science Education,* 10(2), 109 – 128.

KhooYin Yin.(2008).Keberkesanan kaedah penyelesaian masalah secara kolaboratif dalam kalangan pelajar ekonomi tingkatan enam. Doctor of Philosophy Thesis, UniversitiTeknologiMalaysia.

Lakshmi P. andCoffey J. W. (2008). Computer game development : an instructional strategy to promote higher order thinking skills. *Journal of Educational Technology, 5(3),* 40-48.

MarzitaPuteh. (2003). Geometer *Sketchpad*: penggunaannya di dalam pembelajaran matematik tambahan. Doctor of Philosophy Thesis,UniversitiPendidikan Sultan Idris.

McMahon, G. (2009). Critical thinking and ict integration in a western Australian secondary school.*Educational Technology & Society, 12 (4), 269–281.*

Melisa, K., Charmain, C. dan Andre, C. (2015). Programming assistance tools to support the learning of IT programming in South African secondary schools. Computers & Education 82 (2015) 162- 178.

Melisa Su. (2015). Teachingtools, teachers' rules: scratchjr in the classroom. Master's Degree Thesis,Universiti Tufts.

Minarnie Hadzira Binti Mohamad dan Nur Elyani Binti Musa. (2012). Keberkesanan penggunaan alat bahan bantu mengajar dalam pelaksanaan kursus sains kejuruteraan di kalangan pelajar diploma

kejuruteraan di politeknik tuan ku sultan ahbahiyah.*JurnalPendidikan Sains& Matematik 3 (4). 23-48.*

Michael, H. H., Richard L. S. & Gerald, A. K.. (2014). Using a technology-enriched environment to improve higher-order thinking skills. *Journal of Research on Technology in Education.34(2),*109-119.

Mitchel, R., Maloney, J., Hernández, A. M, Rusk, N., Eastmond, E., Brennan, K., Millner, A., Rosenbaum, E., Silver, J., Silverman, B. and Kafai, Y. (2009). Scratch: Programming for Everyone. https://www.researchgate.net/publication/220426817 accessed on 19/10/2016

Mohamed Jamal bin Kamithi. (2016). *Keperihatinan guru sekolah kebangsaan daerah seberang perais elatan di pulau pinang terhadap pelaksanaan KBAT*. Masters Degree Thesis, UniversitiSains Malaysia.

Moura, I., & van Hattum-Janssen, N. (2011).Teaching a CS introductory course: an active approach.*Computers & Education*, Vol. 56, (No.2), Pg 475–483.

NorhidayahMahadi. (2016). *Penggunaan perisian multimedia sebagai bahan bantu belajar dan kesannya terhadap pencapaian dan minat di kalangan murid pendidikan khas bermasalah pembelajaran* .Masters Degree Thesis, UniversitiSains Malaysia.

Nurbiha A Shukor, ZaidatunTasir, Henny Van der Meijden dan Jamalludin Harun. (2013). Exploring students' knowledge construction strategies incomputer-supported collaborative learning discussions using sequential analysis. *Educational Technology & Society, 17* (4),216–228

Nur Sakinah Mohd Isa dan Mohd Nihra Haruzuan Mohamad Said.(2016). Sistem pengurusan rekoddokumen sekolah melalui web berasas kanteori aktiviti .*Jurnal Pendidikan Nusantara, EdisiKhas Jun 2016. ISSN 2289-9375*

Rafiza Abdul Razak, Neela Kandan, and Farrah Dina Yusop. (2015). Experiencing virtual training via e-cpd: analysis of creative thinking skills.*International Journal of Information and Education Technology, Vol. 5, No. 8.*

Salwanibinti Othman. (2015). *Tahap kesediaan dan permasalahan guru dalam mengimplementasikan vlefrogdi sekolah-sekolah menengah daerah kintautara, perak* .Masters Degree Thesis,UniversitiSains Malaysia.

SukimanSaad, Noor Shah DollahdanMohd Uzi (2012).*P*engajarankemahiranberfikir: persepsi dan amalan guru matematik semasa pengajaran dan pembelajaran di bilik darjah. *Jurnal Pendidikan Sains & Matematik Malaysia, 2 (1). pp. 18-36.*

Lee, B. H. (2010). *Conditions affecting computer supported collaborative learning in higher education in the uk and south korea*. Doctor of Philosophy Thesis, University of Birmingham.

SyahanimMohdSalleh, ZarinaShukurdanHairullizaMohamad Judi. (2013). Analysis of research in programming teaching tools: an initial review. *Procedia - Social and Behavioral Sciences 103 (2013) 127 – 135.*

Wan Ismail, W. A, Hamzah M. I. danLubis M. A. (2016). Kesediaanguru pendidikanislam sekolahrendah di Selangor terhadap penerapan KBAT dalam pengajaran dan pembelajaran. *Journal of Advanced Research in Social and Behavioural Sciences, 3(1)*, 79-95.

Yee Mei Heong. (2015).Kesanmanual pengintegrasian strategi pembelajaran dan kemahiran berfikir aras tinggi terhadap penjanaan idea dalam kalangan pelajar teknikal. Doctor of Philosophy Thesis, UniversitiTun Hussein Onn Malaysia.

Zurinabinti Mat. (2016). Penggunaan perisian multimedia dalam pengajaran dan pembelajaran lokus dalam dua dimensi terhadap pencapaian dan minat pelajartingkatan dua. Masters Degree Thesis,Universiti Sains Malaysia.