The Effect of Cooperative Learning Activity in Blossoms Lesson towards Students' Critical Thinking in Learning Chemistry

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ABSTRACT

One of the major barriers that students faced to learn Chemistry is their misconception that memorizing facts and formulas is equivalent to learning. Many studies found that the traditional classes for students were follow a prescribed experimental procedure over a set time. However, the level of learning is limited, and the students are unclear of the aims and how they can apply knowledge that has been learned. In addition, the traditional chemistry classes often leave little room for creativity or contextualization, and as a result, the ability for students to think critically in classroom is impossible to happen. Therefore some research proved that students who performed poorly at the beginning of the course with lower critical thinking have made an improvement much less likely to improve their critical thinking skills while the technology elements such as graphics, animations and videos implemented in teaching and learning in classroom. Thus, this study attempts to investigate the approaches that influence the successful used of BLOSSOMS video in learning Chemistry classroom by integrating cooperative approach by Johnson, Johnson & Smith (1991). This quantitative study involved 29 students and the BLOSSOMS video that selected to be used is "Why Neutralize" which covers the neutralization concept that result from the reaction of acids and bases. The results revealed that almost 97% of students passed the Watson Glaser Critical Thinking Appraisal (WGCTA) Test with Level 4 which is Practicing Thinker and above. Therefore, it can be concluded that learning by BLOSSOMS video have a positive impact on the students not only in academic achievement but also able to inculcate students' critical thinking.

Keywords: Chemistry, BLOSSOMS, Critical Thinking, Cooperative Learning,

Introduction

Technological advancement not only influenced in the way people communicate with each other, but also has provided more accessibility and more flexibility in the way education can be delivered to people. Previous studies by Russell (2003) says, educators are adept at using technology is more likely to use it as a medium of instruction in the classroom. These can lead to major implications for teaching and learning in the classroom and the field of research (Rusmini, 2003). According Rusmini (2003), interactive materials which develop by using multimedia elements such as graphics, text, music, video and animation helps to strengthen students' understanding to one concept in teaching and learning. According to Greenberg and Zanetis (2012), texts, oral presentation, recorded audio, slides, and other forms of media invite enhancement by video. Video does not just add emphasis, but it is becoming central to learning, a need felt not only by students who are growing up with rich digital technologies, but also increasingly by educators.

When focus on learning through video especially in Science and Mathematics, Blended Learning Open Sources Science or Mathematics Studies or known as BLOSSOMS by Massachusetts Institute of Technology (MIT) was launch in 2013. This project was started when Richard Larson and Elizabeth Murray, a professor of engineering systems at MIT and an early advocate of educational technology, visited a run-down school in rural central China which emphasized learning using video through blended learning. They envisioned video lessons dovetailed with engaging activities for teachers to do with their students. This project gave impact on the teaching and learning process in

Sciences and Mathematics. According to Annie (2014), MIT BLOSSOMS is one of the most exciting and effective uses of educational technology to help high school students learn Sciences and Mathematics which engaging both students' and teachers' roles.

Literature Review

Difficulties in Learning Chemistry Subject

Chemistry is often regarded as a difficult subject which sometimes repels learners from continuing with studies in Chemistry (Sirhan, 2007). Many students from secondary schools to universities in many countries struggle to learn Chemistry and experience difficulties do not succeed at the end of the result (Reid, 2008). Research conducted by Child (2009), reveals the gap of communication between students and teachers is one of the reason why student cannot understand better.

Despite the content of Chemistry subject which is abstract that lead to difficulties for student to understand, the traditional teaching method by chemistry teachers may lead students failed to understand Chemistry concept. Besides, according to Kolumuc and Tekin (2011), one of the reason why Chemistry hard to learn was lack of active learning during teaching and learning process. Furthermore, Further and Bligh (2000) stated that the lecture method is a relatively poor instructional approach for maintaining student attention and his research findings found that student concentration during lectures begins to decline after 10-15 minutes. This can be supported by Knight and Wood (2005) that reported the results of implemented active learning in class showed that when in-class activities is place of some lecture time, collaborative work in student groups increased in-class formative assessment and group discussion were observed to make significantly higher learning gains and better conceptual understanding.

Morover, most students are familiar in solving multiple choices questions and routine problems which requires low order thinking skills (LOTS) (Jensen et al., 2014). This scenario has contributed to the poor achievement of Malaysian students in PISA (Malaysian Ministry of Education, 2012) because they have been familiarised with lower-order and intermediate cognitive skills of problems which include the level of knowledge, comprehension and application. Lack of problem solving ability and skill to develop problem solving competency among students may hinder our standard of education to generate global future leaders. Thus, educators need to design an appropriate teaching and learning strategy in order to enhance students' critical thinking.

Maluku, Harrison and Temechegn (2014) reported learning difficulties can be categorized into 3 which are a) learning environment related, b) teacher related and c) course related. There are 5 factors highlighted for learning environment which are lack of rapid reward, lack of scientific language, lack of continuous assessment, no specific feedback questions and teacher's ego stroking and class room environment. For teacher related factors are no teaching strategy, teacher centered teaching, finding unlikely or complex solutions, fewer problem solving, inadequate lecturer and not seeing how the parts are related to each other. For course related, the found that fixation at low level of questioning, needs numeracy skills, abstract concepts, confusing technical meaning and overloaded course content. As a result, students feel bored with the learning methods in Chemistry, becomes no motivation, difficult to understand scientific language and failed to make a scientific reasoning (Mary, Henry and Jackson, 2000). Therefore, to overcome these difficulties in learning Chemistry, the use of technology elements will help to enhance students understanding towards Chemistry subjects such as the use of simulation, videos and etc.

Learning Chemistry Through The Use of Video Technology

According to ITWORX Education (2015), video has been part of education since the 1960s and over the years, its popularity has risen and fallen, as new waves of technology have repeatedly reignited its potential. Beside, throughout there is been a continuous trend towards lower production costs, easier technical requirements and increasing access and these factors have generally made video more attractive as a teaching and learning tools. Video is a medium that engages viewers from multiple senses – sight and sound – and can generate excitement about a subject or concept.

Students will enjoy the experience and retain more information from the class. Research by Willmot (2012) showed that there is strong evidence that digital video reporting can inspire and engage students when incorporated into student-centered learning activities.

Allam (2006) observes that the creative challenge of using moving images and sound to communicate a topic indeed engaging and insightful, but adds that it also enables students to acquire a range of transferable skills in addition to filmmaking itself. These include research skills, collaborative working, problem solving, technology, and organisational skills. More recently, Willmot (2012) show that there is strong evidence that digital video reporting can inspire and engage students when incorporated into student - centred learning activities through: increased student motivation, enhanced learning experience, higher marks, development potential for deeper learning of the subject, development of learner autonomy and also enhanced team working and communication skills.

Alexandra et al., Kenneth (2004) in their study on The Use of Video Demonstrations and Particulate Animation in General Chemistry found that the use video techniques have been used for teaching Chemistry concepts and result shown that when animations and video demonstrations are used, students seem to better correlate all the concept representation in theory. For Goll et al. (2009) and Wink (2001) presented their studies on the use of movies and film to anchor discussions of chemistry concepts in real-world or dramatic scenarios. David (2012) stated that by comparing learning with-videos and learning with no-videos sample data, the most significant findings are that videos used by helps them to improve initial learning and improve course grades for Chemistry. This aligned with the research finding by Inci, Soner, Özge and Seçil (2004) where the usage of videos in computer-assisted teaching methods such as for teaching a fundamental topic within Chemistry education have significant result towards student achievement compared to traditional teaching methods.

In 1997, Rusell research finding claims that by using video clips, molecular animations, text and graphs in Modules on General Chemistry topics enhanced conceptual understanding among students. This aligned with research conducted by Sanger (2001), where students that viewed video animations of the diffusion of perfume molecules and osmosis of water molecules in Chemistry developed more accurate conceptions of these processes based on ideas of the random motion of molecules. Thus, with the demand of using video in teaching and learning especially in learning science subject, BLOSSOMS video lesson was initiated. By using BLOSSOMS video lesson, students will not feeling lost in class since BLOSSOMS videos teach abstract concepts through the joining of observation, experience and discussion that promotes students understanding towards the knowledge better.

Integrating BLOSSOMS Lessons to Help Students Learn Chemistry

BLOSSOMS stands for Blended Learning Science or Mathematics Studies video based. Each lesson from Blossoms video offers a series of small video segments as well as a teacher's guide to coordinate the active learning sessions. Perhaps by integrating Blossoms videos in teaching and learning, a number of myths or misconceptions concerning the use of visualizations in the classroom exist can be reduced. The video lessons intended to enhance the teaching of Science, Technology, Engineering and Mathematics (STEM) lessons by the lively video presence of experts in the field. Students in the classroom setting would watch segments of a BLOSSOMS video (4 to 6 segments), no segment lasting longer than 5 minutes. Then after each segment, the in-class teacher would guide or facilitate the students through an active learning exercise building from the video segment and provided by the presence expert. After the learning objective is accomplished, the video is turned on again for another short segment. This iterative process continues until the exercise is over, usually lasting a full class session. The segments of the video are designed to explain complex STEM concepts, by relating them to real-world situations. Students have to engage in active learning activities, such as discussion, problem solving that promote analysis, synthesis, and evaluation of STEM content. In BLOSSOMS lesson, the combination of learning through video and in real class activity is how the blended learning approach being implemented. This is how the blended process occurred when integrating BLOSSOMS video in classroom teaching.

Bonk and Graham (2005) described blended learning systems as a combination of face-to-face instruction and computer-mediated instruction. Besides, Fox (2002) define blended learning as the ability to combine elements of classroom training, live and self-paced e-learning, and advanced supportive learning services in a manner that provides a tailored learning. According to Rooney (2003), the American Society for Training and Development identified blended learning as among the top 10 trends to emerge in the knowledge delivery industry. Beside, Rooney (2003) added, blended learning is one of the approach to make learning through video are meaningful.

For Jeffrey (2014), blended learning offers the potential to create effective training, to save time and money, to make training more engaging and convenient for learners, and to offer learning professionals the chance to innovate. In addition, blended learning is a way of preparing students for the 21st century workplace, which is increasingly based on information and services. As cited by Hannover (2011), students in blended learning are generally more active and interactive learners than students who partake solely in online courses – they communicate more readily among themselves, with their instructors, and with outside resources. This applied in BLOSSOMS lesson which behind it is blended learning theory. As mentioned before, BLOSSOMS lessons involved watching video and in real time class activity. Therefore, the activities conducted by students also need a proper guideline in order for them to engage meaningfully during the class activity. Active approach such as cooperative learning perhaps will be engaged students during the in class activities.

Cooperative Approach to Engage Students in BLOSSOMS Lesson

BLOSSOMS lessons allow students to do hands on activity during the segment break within learning process. When referring back to the videos, all activities are suggested to conduct by discussion in pair or in a group. This shows that the activities can be conducting cooperatively among the students. However, there are no a proper guideline provide in order to conduct cooperative learning during completing the task given. According to Hobert (2005), pair work and group work increase the amount of student practice. Pair work and group work have advantages not only for the learners but also for the teachers. First of all they save time. Instead of asking individual students to practice a structure or answer the questions, he or she can divide the class into pairs and make them do the activity at the same time. Another extremely important advantage of pair work and group work is increasing learner's confidence (Hubert, 2005).

To be cooperative, a group must have clear positive interdependence, members must promote each other's learning and success face to face, hold each other personally and individually accountable to do his or her fair share of the work, appropriately use the interpersonal and small group skills needed for cooperative efforts to be successful, and process as a group how effectively members are working together. All these five essential components must be present for small group learning to be truly cooperative as highlighted by Johnson, Johnson & Smith (1991). Johnson, Johnson & Smith (1991) describe five elements needed for successful cooperative learning. These essential elements should be carefully structured within all levels of cooperative efforts. Therefore, by integrating BLOSSOMS video lesson and applying five elements of Johnson, Johnson & Smith (1991) cooperative learning approach in classes, it will help in preparing students to improve their chances to engage actively, think critically, understand the concept by doing in group by themselves.

Using BLOSSOMS Video to Increase Students Critical Thinking

According to Barahal (2008), critical thinking includes definitions that refer to 'reasonable, reflective thinking that is focused on deciding what to believe or do' and 'artful thinking', which includes reasoning, questioning and investigating, observing and describing, comparing and connecting, finding complexity, and exploring viewpoints. Besides, Robyn (2014) stated that in critical thinking, being able 'to think' means students can apply wise judgment or produce a reasoned critique. The goal of teaching is then to equip students to be wise by guiding them towards how to make sound decisions and exercise reasoned judgment. Critical thinking are important because they enable students "to deal effectively with social, scientific, and practical problems" (Shakirova, 2007). To put it another way, in order for being able to live, work, solving problems, and making decisions effectively in our constantly changing world, merely having knowledge or information is not enough, learners must be able to think critically. Findings of research in this vein showed that instructional approaches such as concept mapping (Khodadady & Ghanizadeh, 2011), problem-based learning (Nargundkar, Samaddar, & Mukhopadhyah, 2014), inquiry and questioning approach (Shen & Yodkhumlue, 2012) contribute to critical thinking. Recently, a comparative study investigating the effects of different instructional approaches on critical thinking in online learning settings showed that engaging technology elements such as video was the most effective in advancing critical thinking skills (Alelioğlu & Gülbaharand, 2014).

Video has been used widely as one method to deliver content in teaching and learning (Sehrine, 2009). Van Es (2007) founds that video context also enabled the development of teacher community and how that community helped the participants to think critically and accomplish the goals. According to Izzati and Norasyikin (2014) in their research on "Enhancement of Student Motivation in Learning through BLOSSOMS Video Activity", video activities forces

students to create connections, delve to find deeper meaning, and create understanding and by using appropriate digital tools and resources, engagement can leads students to apply critical thinking skills specifically into, solving the problems, making the decisions, managing the projects, planning and conducting the research. Therefore, BLOSSOMS video lesson is a tool that can stimulate an interest in young people toward learning mathematics, science & engineering; as well as develop critical and creative thinking skills which can lead to a more active and problem-based learning.

In addition in BLOSSOMS video lesson, each activitiy has been arranged in Bloom's Taxonomy domains. Bloom's Taxonomy promote higher forms of thinking in education in 6 levels; Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation. When refer back to the BLOSSOMS video content, BLOSSOMS video lesson activities cater level 3 to level 6 of Bloom's Taxonomy domains which are analysis, synthesis and evaluation for every lesson produced. Therefore, reliability of BLOSSOMS videos lesson can be rely on increasing students' critical thinking.

Methodology

In this research, pre-experimental one-group pre-test – post-test design was used which involved 29 Form 4 (age=16 years old) students from one of cluster school in Johor Bahru District, Malaysia. At the beginning of the lesson, a set of Watson Glaser Critical Thinking Appraisal (WGCTA) Pre-Test were handed out to each student and took no longer than 30 minutes to complete. The learning process continued to gather students' critical thinking information using BLOSSOMS lessons by integrating cooperative learning strategy by Johnson, Johnson & Smith (1991) who highlighted five principles to implement in teaching and learning process; a) positive interdependence, b) promotive interaction, c) individual and group accountability and d) interpersonal and small group skills and e) group processing For this learning process phase, there are 6 activities throughout the BLOSSOMS lesson. Figure 1 illustrates the 6 activities for critical thinking process involved according to Bloom's Taxonomy domains which are inference, recognition assumption, deduction, interpretation and evaluation. At the same time, the 5 cooperative learning principles by Johnson, Johnson & Smith (1991) also being applied (Noor Dayana et al, 2017). After completing activity 6, Watson – Glaser Critical Thinking Appraisal (WGCTA) Post-Test was administered to measured students critical thinking

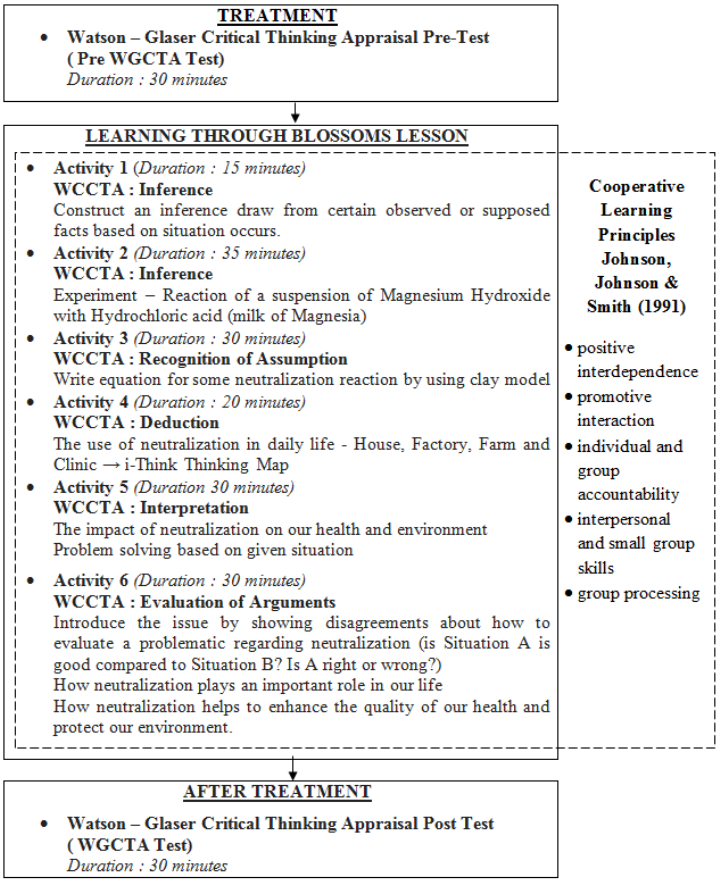

Figure 1: Research Procedure

Findings

Watson Glaser Critical Thinking Appraisal (WGCTA) test is used to measure students' critical thinking after learned using the BLOSSOMS lessons. The WGCTA is a multi-faceted measure of critical thinking. The five subtests require different, though interdependent, applications of analytical reasoning in a verbal context with scores reported on 15 marks. There are 5 open-ended questions with 15 marks in total and the duration provided for this test is 30 minutes. Descriptive analyses were used to summarize Watson- Glaser Critical Thinking Appraisal Test at the beginning (Pre-test) and end (Post-test) of data analysis. To investigate the effect of BLOSSOMS video lesson towards students' critical thinking in learning Chemistry, paired sample t-test was run to compare the significant differences between before and after the BLOSSOMS video lesson has been conducted.

Before the treatment, the mean of the students' marks for the WGCTA Pre Test was found to be 41.59 and it showed an increment in the mean percentage, with a value of 73.34 WGCTA Post Test. Therefore, the difference between the mean values proved that students had an improvement in developing their critical thinking after learning through BLOSSOMS video lesson. Therefore, by referring to Table 1, since the p-value is less than 0.05 ($p < 0.05$), thus the H_0 was rejected where H_1 was accepted. Thus, it can be concluded that BLOSSOMS video lesson resulting positive effectiveness toward students' critical thinking in learning Chemistry subject.

Table 1: Significant difference between the mean of the students' critical thinking in Pre and Post WCGTA Test

	N	Mean Difference	t	Sig.

Pair 1 Pre-Post WGCTA	29	41.59-73.34=-31.759	-25.896	.000

Discussions

To measure the effect of cooperative learning activities in BLOSSOMS video lesson towards students' critical thinking, each stages in BLOSSOM video lesson is well-designed with blended learning environments and was arranged accordingly to Bloom's Taxonomy domains. According to Watson and Glaser (1994), the Watson-Glaser Critical Thinking Appraisal measures the critical thinking skills that are necessary for presenting in a clear, structured, well-reasoned way, a certain point of view and convincing others of arguments. Hence, Barahal (2008) stated, BLOSSOMS video lessons intersperse video instruction with planned exercises that engage students in problem solving and critical thinking, therefore it helps students to build the kind of gut knowledge that comes from hands-on experience. Barahal (2008) added, by guiding students through activities from beginning to end, BLOSSOMS video lessons give students a sense of accomplishment and excitement.

Bloom's taxonomy was adopted in the detailed of activities in BLOSSOMS video lesson. The level of difficulty of each activity was indicated from easy level to hard level, started from the knowledge, comprehension, application, analysis, synthesis and evaluation to specify objectives so that it becomes easier to plan learning experience and prepare an evaluation process. According to Stacia (2014), after asking several higher level Bloom's Taxonomy questions, during various conversations, students' ability to think critically can be seen. Stacia (2014) added, even though it may take some time for students to process and be able to respond, but with practicing higher level questioning will enhance their critical thinking level to the higher stage.

The concept of cooperative learning, the grouping and pairing of students is for achieving an academic goal in BLOSSOMS video lesson. After conducting a statistical analysis on the critical thinking test scores, it was found that students who participated in cooperative learning had performed significantly better on the critical- thinking test. According to Vygotsky (1978) , students are capable of performing at higher intellectual levels when asked to work in group situations. Group diversity in terms of knowledge and experience contributes positively to the learning process. Anuradha (1995) contends that cooperative learning methods improve problem- solving strategies because the students are confronted with different interpretations of the given situation. Moreover, the peer support system makes it possible for the learner to internalize both 82 external knowledge and critical thinking skills and to convert them into tools for intellectual functioning.

In this research, the data were analyzed to indicate the critical thinking level before and after learning through BLOSSOMS video lesson. Result from data analysis found that there is significant difference between the mean of the students' critical thinking level in Watson Glaser Critical Thinking Appraisal Test. The final result shows that the students' critical thinking score marks obtained is 97% of the students pass the test with Level 4 and above. Zhang (2010) believed that the more attractive methods in teaching and learning should be implemented as the use of technology could improve learning process and enhanced students to think critically. Gee (2003) also agreed that teaching and learning through videos makes teaching and learning more enjoyable and indirectly inspire students to think critically.

Thus, it can be concluded that cooperative learning activities in BLOSSOMS video lesson helps students in answering critical thinking questions with respect to Chemistry subject. This finding also proves that learning Chemistry using BLOSSOMS video lesson give a positive effect on students' critical thinking in learning Chemistry.

Conclusion

The method of teaching in the classroom may not be understood by all students, therefore the demand of technology that sparked the interest among students can be implemented in teaching and learning in classroom to get better understanding and further enhanced students' critical thinking. Nowadays, the majority of students are considered as technology-savvy high school student, therefore, this BLOSSOMS video lesson approach is proving to be very effective in a way to deliver the content in teaching and learning process. In addition, by engaging with media elements such as animations, graphics, videos, interactive courseware, the process of teaching and learning in classroom become more active and enjoyable. From the data analysis, the result shows the positive effect of cooperative learning activity

in BLOSSOMS video lesson towards students' critical thinking. This proved that, BLOSSOMS video lessons are enriching students' learning experiences in classroom especially in Chemistry subject. The lessons intersperse video instruction with planned activities that engage students in problem solving and critical thinking, helping students build the kind of gut knowledge that comes from hands-on experience. By guiding students through activities from beginning to end, BLOSSOMS video lessons give students a sense of accomplishment and excitement during teaching and learning session.

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References

Alexandra; V. M., Ashkenazi, G., Tasker, R., & Kenneth C. (2004). The Use of Video Demonstrations and Particulate Animation in General Chemistry. *Journal of Science Education and Technology*, v13 n3 p315-323 Sep

Allam, B. (2006). Blended Learning Tools for Teaching and Training. Facet Publishing, London

Annie, W. (2014). Creating Engaging Openers Through Story: Developing Pre-service Teachers' Understanding of Sustainability Using Digital Video. In *Proceedings of Society for Information Technology & Teacher Education International Conference 2014* (pp. 461-464). Chesapeake, VA: Association for the Advancement of Computing in Education (AACE). Retrieved June 1, 2014 from https://www.learntechlib.org/p/171716

Anuradha A. Gokhale (1995). Collaborative Learning Enhances Critical Thinking. Journal of Technology Education . Vol. 7 No. 1

Barahal, S. (2008). Thinking about thinking: Preservice teachers strengthen their thinking artfully. Phi Delta Kappan 90 (4): 298–302.Bligh, S. L. (2000). Motivation in high school science students: A comparison of gender differences in life, physical, and earth science classes. *Journal of Research in Science Teaching*, 45 (8), 955-970.

Bonk, C. J. & Graham, C. R. (Eds.). (2005). Handbook of blended learning: Global Perspectives, local designs. San Francisco, CA: Pfeiffer Publishing.

Child, D. (2009). Teaching with technology: Creating student-centered classrooms. New York: Teachers College Press

David, Y. (2012). Changing classrooms: A study of good practices in using ICT in Hong Kong Schools. Hong Kong: Centre for Information Technology in School and Teacher Education, University of Hong Kong.

Fox, M. (2002). Keeping the blended promise. E-learning 3(3), 26-29.

Gee, J. P. (2003). Situated Language and Learning: A Critique of Traditional Schooling. London: Routledge.

Goll, R. (2009). How Video Production Affects Student Engagement: An Empirical Study of MOOC Videos. ACM Conference on Learning at Scale 2009.

Greenberg, A., & Zanetis, J. (2012). The impact of broadcast and streaming video in education [white paper]. San Jose, CA: Cisco. Retrieved from http://www.cisco.com/web/strategy/docs/education/classromconnect05 3012.pdf

Hannover, A. P. (2011). Teaching and Learning with Technology. Pearson Education.

Hobert, D. (2005). How Motivation Influences Student Engagement: A Qualitative Case Study. Journal of Education and Learning, 1 (2), 252-267.

Incil, M., Soner, A., & Secil, Y. (2004). The influence of computer-assisted education on environmental knowledge and environmental awareness. Chemistry Education: Research and Practice, 5, 99-110.

ITWORX Education (2015). Reconsidering research on learning from media. Review of Educational Research, 53(4), 445-459.

Izzati, N., & Norasyikin, M.(2014). Enhancement of Student Motivation in Learning through BLOSSOMS Video Activity. American Scientific Publisher, 4, 400-407, 2014.

Jeffrey, L. M. (2014). Blended learning: How teachers balance the blend of online and classroom components. Journal of Information Technology Education: Research, 13,121-140. Retrieved from http://www.jite.org/documents/Vol13 /JITEv13ResearchP121-140Jeffrey0460.pdf

Jensen, J. L., McDaniel, M. A., Woodard, S. M., & Kummer, T. A. (2014). Teaching to the test… or testing to teach: Exams requiring higher order thinking skills encourage greater conceptual understanding. Educational Psychology Review, 26(2), 307-329.

John, J. M. (2013). Learning with Technology: Evidence that technology can, and does, support learning [white paper]. Cable in the Classroom

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1991). Cooperative learning: Increasing college faculty instructional productivity. ASHE-ERIC Report on Higher Education. Washington, DC: The George Washington University.

Khodadady, K & Ghanizadeh, A. (2011). An investigation into the relationship between self-regulation and critical thinking among Iranian EFL teachers. The Journal of Technology of Education, 5(3), 213-221

Knight, J. K., & Wood, W. B. (2005). Teaching more by lecturing less. Cell Biology Education, 4, 298-310.

Kolomuc, A., & Tekin, S. (2011). Chemistry Teachers' Misconceptions Concerning Concept of Chemical Reaction Rate. Eurasian Journal of Physics and Chemistry Education, 3(2), 84-101.

Maluku, C. J., Harrison, J. H., & Temechegn, H. H. (2014). What makes chemistry difficult ? Parallels between adolescents' conception of gases and the history of chemistry. Journal of Chemical Education, 64(7), 616-618.

Ministry of education Malaysia. (2012). Preliminary report: Malaysia Education Blueprint 2013- 2025(Preschool to Post-secondary Education). Kuala Lumpur: Goverment of Malaysia.

Nargundkar, S., Samaddar, M., & Mukhopadyah, H. (2014) "An Empirical Investigation of Student Evaluations of Instruction—The Relative Importance of Factors," Decision Sciences Journal of Innovative Education, Volume 10, Issue 1, pages 117–135, January 2014.

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In Blossoms Lesson Towards Students'Achievement In Learning Chemistry Man in India, 97 (19). pp. 323-329.

Reid, K. (2008). Creating kick butt quality online courses. Seminar within Linked Campuses International Network. Retrieved June 20, 2011 fromhttp://lcin.wordpress.com/2007/10/06/resource-links-or-reeve-et-al-talk

Richard L. (2006). Open Educational Resources for Blended Learning in High Schools: Overcoming Impediments in Developing Countries. Journal of Asynchronous Learning Networks 12 (1). Link to Journal worldwide educational assessment. Computers & Education. 37, 163-178.

Robyn, A. (2003). Development of critical thinking through problem-based learning: A pilot study. Journal on Excellence in College Teaching 11(2&3): 203-226.

Rooney, J. E. (2003). Knowledge infusion: Blending learning opportunities to enhance educational programming and meetings. Association Management, 55(5). Retrieved February 13, 2005, from InfoTrac database.

Rusell, K. (2003). Can Blended Learning Be Redeemed? E-Learning and Digital Media, 2(1), 17-26.

Rusmini, K., A. (2003). Integrasi Teknologi Maklumat dan Komunikasi Dalam Pengajaran dan Pembelajaran. Institut Aminuddin Baki Cawangan Utara. Jitra, Kedah.

Salman, K. (2011). Blended learning: lets use video to reinvent education. Franchising World, 35(4), 22-23.

Sanger, C. R. (2001). Five powerful ways technology can enhance teaching and learning in higher education. Educational Technology.

Sehrine, K. (2009). Flipping the Classroom Facilitates Active Learning Methods. Emerging Ed Tech. 3 November 2009. Retrieved from http://www.emergingedtech.com/2013/11/flipping-theclassroom-facilitates-these-5-active-learning-methods-and-much-more/

Shakirova, D. M. (2007). Technology for the shaping of college students' and upper-grade students' critical thinking. Russ. Educ. Soc., 49(9): 42-52.

Shen, P. & Yodkhumlue, B. (2012). A case study of teacher's questioning and students' critical thinking in college EFL reading classroom. International Journal of English Linguistics. 2(1), 199-206.

Sirhan, G. (2007). Learning Difficulties in Chemistry: An Overview, Journal of Turkish Sciences Education, Volume 4, Issue 2, pp2-20.

Thomas, P,. T. (2007). College physical chemistry students' conceptions of equilibrium and fundamental thermodynamics. Journal of Research in Science Teaching, 35(10), 1151-1160.

Van Es, E,. A. (2009). Participants' roles in the context of a video club. Journal of the Learning Sciences, 18(1), 100-137.

Wilmot, L. (2012). Courses and instruction affecting critical thinking. Research in Higher Education, 40, 185-200.

Wink, M,. J. (2001). A course designed to improve psychological critical thinking. Teaching of Psychology, 34, 153-157.

Zhang, Y. (2010). Cooperative Language Learning and Foreign Language Learning and Teaching. Journal of Language Teaching and Research.Vol.1, No.1, 81-83. January 2010.