



Students' Self-Controlled Learning (SCL) of Chemistry

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ABSTRACT

Senior High School students are highly exposed to technology. They are using multimedia as a catalyst in learning chemistry. Multimedia Based Learning (MBL) in schools for that matter classroom instruction increased widely. The use of multimedia tools improves students' attitude and also their learning outcomes. The study was probing the impact of MBL toward students' Self-Controlled Learning (SCL) in chemistry learning. The experiment was conducted in SHS 2 of Theocracy Senior High School. Researchers introduce some computer-based media for chemistry materials and continued with expert judgement of the media. Students' data SCL were measured using validated questionnaire. The questionnaire consists of three components, i.e., metacognitive, motivation and behaviour. The results showed that there were significant differences in SCL of students before and after participating in chemistry teaching and learning which applying MBL.

Keywords: *Multimedia Based Learning, Self-Controlled Learning, metacognitive*

Introduction

Chemistry is a nucleus and pivot of science that always ready to find answers to the questions of 'what things happening, how the thing happening and why the thing happening related to the composition, structure and properties of a substances. There are two concepts of chemistry. These are the chemistry as products (chemistry knowledge in the form of facts, concepts, principles, laws, and theories) and also chemistry as the processes (scientific work) (Retno Dwi Suyanti, 2010).

In the kingdom of chemistry teaching and learning in a senior high school, the master of the subject (the teacher) must use different concepts and techniques within a specified time limit to execute the lesson for objectives to be achieved. At the end of the lesson, the teacher can only resolve the matter but has to create avenue for students to practice and prove chemistry concept. This must happen mainly on topics that needs a lot of constant practice, such as acid-base, energy and energy changes, etc.

Based on research observations in some of senior high school in Akuapem South District, all the chemistry teaching and learning has been supported by laboratory facilities and adequate technology for senior high school such as LCD projector, screen, and speakers that are mounted on each class. However, the teacher in the teaching and learning process less utilize these facilities for the application of Multimedia Based Learning (MBL).

Several investigations have been conducted on the effectiveness of multimedia teaching methods in improving senior high school students' academic achievement in Ghana. A study by Adu-Gyamfi et al. (2021) found that the use of multimedia instruction significantly improved senior high school students' performance in science subjects.

According to (Nazir, et al, 2012), Multimedia Based Learning is a teaching and learning method that applies a blend of interactive media and accompanied by text, static images, dynamic images and or video in the delivery of the subject matter. The main usage of this method is creating better teaching and learning process, faster and foster independent learning attitude (Lightbody, et al, 2006). In addition, through the MBL, teachers can deliver more innovative materials and motivate students to study harder (Nazir, et al, 2012). Delivery of teaching materials through the MBL, it would be much more effective than just the teacher delivering a lecture course material (Osamah, et al, 2010).

Multimedia-based learning has been found to improve student understanding of science concepts and increase their critical thinking and problem-solving skills (Mohammed *et al.*, 2020; Mohammed & Amponsah, 2021a; Mohammed & Amponsah, 2021b).

In other to calculates the success of the teaching and learning process, there must be students' self-regulated learning (SCL). The teaching and learning involve students what to do for herself or himself, the initiative must come from himself. Education experts agree behold SCL is an important factor in the motivation of learning (academic motivation) and learning outcomes (academic achievement) (Zumbrunn et. al., 2011). Zimmerman in Greene et. al. (2011) states that the SCL is a form of the attitude of a student to monitor and control aspects of cognition, motivation, habits, and emotions according to the environment or circumstances are always changing in the learning process. Students who apply SCL means the student to plan, monitor and assess their own learning (Zumbrunn et. al., 2011). Turan (2010) claim that the students who have academic value (learning outcomes) higher will tend to have a higher SCL and vice versa.

From the above description, it can be concluded that students SCL is very important to the success of students in school. Therefore, this study aims to determine the successfulness of the introduction of MBL on chemistry teaching and learning toward the students SCL.

Materials and Methods

This research was an experimental study of observation under artificial conditions. The method used in this study is a quantitative. Thing means that all information or data realized in the form of numbers. Data were analyzed statistically, then the result was described.

Study population

The study was Targeted at chemistry students in senior secondary schools. Specifically, the study population of comprised all SHS 2 Chemistry students in the selected Schools.

Research Variables

The independent variable in this study was the method of chemistry teaching and learning. The dependent variable was students SCL. The control variables were the teacher, the students' prior knowledge, the chemistry topic being taught, and the number of meetings.

Sampling Techniques

This study was held in SHS 2 of Theocracy SHS. The sampling technique was simple random sampling. There were two classes taken as an experimental class and as a control class. The experiment class was Science A which consist of 37 students. The control class was Science B consisting 36 students. The experiment class using MBL in chemistry teaching and learning, while control class was not.

Research Instruments

The research instruments were (1) lesson plans; (2) computer based media; and (3) SCL questionnaire. All the instruments were validated by the expert. The SCL questionnaire adapts to the SCL components proposed by Zimmerman (1989). It was consist of three components, i.e. metacognitive, motivation and behavior.

Table 1. Aspects of Students SCL Questionnaire

Components	Observed	Number of questions
Metacognitive	1. Tenacity in the face of adversity	5
	2. The desire to learn more about the material being studied	5
	3. The interest in a variety of issues	3
	4. Responsible for the opinions	3
	5. Self-evaluation	5
Motivation	1. The desire to perform better	3
	2. Looking for chemistry problem and solve it	3
	3. Planning strategies and learning objectives	4
Behavior	1. Completing the tasks	4
	2. Attempts to perform at their best	4
	3. Glad to learn chemistry	4
	4. Time management	4
	5. Self-observation for the implementation of learning strategies	4

Data Analysis

Firstly, data were tested for homogeneity and normality. Then, data were analyzed statistically using t-test (independent sample t-test and paired sample t-test).

Result and Discussion

Both experiment and control classes, the chemistry teaching and learning takes 5 meetings. Topic presented in all classes were same, which is acids and bases. As for the difference between two classes was the chemistry teaching and learning methods. Experiment class was using MBL, while control class was not (only lecture method).

Media used in experiment class quite varied, including PowerPoint, video and Flash. The example of media used shown in the picture below.

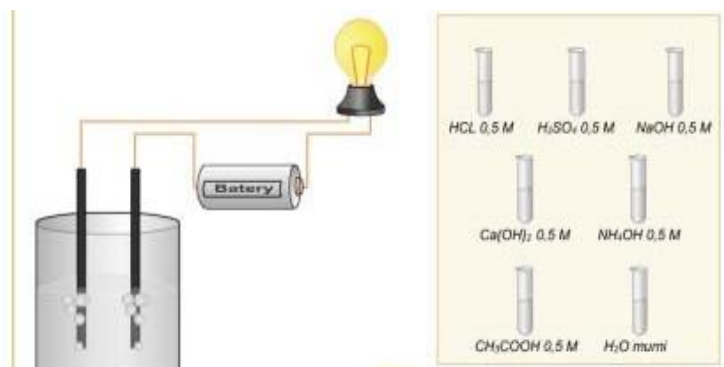


Figure 1. Media on strength of acids and bases using Flash

SCL data can be divided into two. These are, the SCL data before the learning process and SCL data after the learning process. SCL questionnaire used was a questionnaire enclosed model with five (5) different answer options, which were always (1), Often (2) Sometimes (3), rare (4), and Never (5). This questionnaire consists of 51 items that include positive statements or negative statements. Both the control class and experiment class, the students' SCL was increased. The average value of students SCL are shown in Figure 2 below.

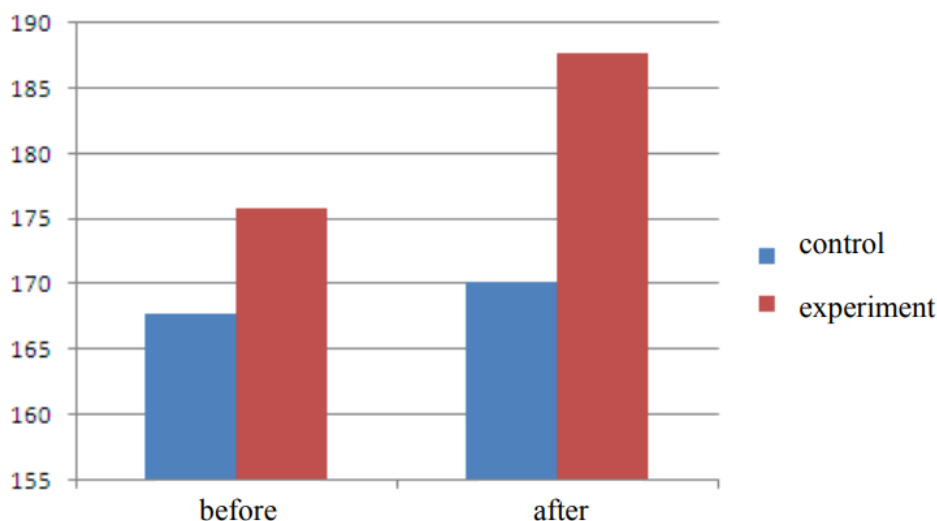


Figure 2. The average value of students' SCL before and after the learning process.

Based on the analysis using the independent sample t test (in SPSS 16 computer program), it was known that $t(2.072) > t \text{ table}(1.99394)$ and $p(0.042) < \alpha(0.05)$. It can be concluded that there were significant differences between the students' SCL who take chemistry study using MBL with students who take chemistry without using MBL.

Based on the analysis of the paired sample t-test (in SPSS 16 computer program), t value obtained 10,206 with $p = 0.000$. This value is much larger than t table of 2.028 at a significance level of 0.05. It can be concluded that there were significant differences between the students' SCL before and after participating in learning chemistry using MBL.

How can MBL increase students' SCL?

The implementation of MBL in chemistry teaching and learning can improve the students' SCL because MBL can create the opportunity for students to control their own learning rate. Controlling learning rate is part of SCL component, which is a behaviour. In addition, MBL also provide the opportunity for student in decisions making, especially time management and the matter they have to learn.

The increasing of students' SCL in the experimental class also due to the function of MBL itself (Daryanto, 2010), i.e. :

- a) It is able to amplify the user's response as soon as possible and as often as possible
- b) It is able to provide the opportunity for students to control the pace of their own learning rate.
- c) It is able to provide opportunities for the participation of the user in the form of response, either in the form of an answer, decision, trial, and others.

The results of this study also supported by several studies showing that students with good SCL tend to have more confidence and choose a destination that is more challenging than others. By setting goals and regularly re-evaluate the successes and failures in achieving its objectives, then their self-efficacy will increase (Zimmermen et.al., 1996). Self-efficacy can also increase effort, persistence, and learning outcomes [Bandura, 1986]. Self-efficacy is part of SCL that can improve learning outcomes. Then it can be presumed that the SCL can improve learning outcomes, so that SCL has a positive relationship with learning outcomes.

Conclusions

The result of this study showed that there were

- (1) significant differences between the students' SCL who take chemistry study using MBL with students who take chemistry without using MBL
- (2) significant differences between the students' SCL before and after participating in learning chemistry using MBL

Acknowledgement

I wish to acknowledge the students who voluntarily took part in this study as well as the school authorities who gave permission to the researcher to conduct the study.

Funding

No funding was obtained by the researchers to conduct this study.

Author's Biography

Dr Raphael Foster Ayithey had his Secondary Education at Obuasi Secondary Technical School, Obuasi in 1997. He taught as a Pupil Teacher for three years after completion. He then proceeded to Teacher Training College where he completed in 2004. In 2008, He enrolled as B.E.D Science Education student at University of Education, Winneba and passed out in 2012. While at the University of Education Winneba, he had been teaching Chemistry in Theocracy Senior High School at Pokuasi. The author had also the following degrees:

- Master of education in science education- Med (Chemistry) at UEW
- Master of philosophy- MPHILS (science education- Chemistry)- UEW
- Doctor of philosophy- PhD Chemistry – Manhattan Bay University - USA

Presently, Dr. Ayithey Raphael is a Chemistry Tutor in West Africa Senior High School in Accra and the Head of Science Department in Theocracy Senior High School. 'Sir Raph' is also a seasonal chemistry examiner for WAEC. He is currently a part-time lecturer in Ghana's number one university (University of Ghana, legon)

References

- Adu-Gyamfi, S., Osei-Tutu, E., & Duodu, E. (2021). The impact of multimedia technology on senior high school students' performance in science subjects in Ghana. *Journal of Education and Learning*, 10(1), 1-12.
- Amponsah, K. D., Boateng, F. K., & Mohammed, S. M. (2021). Pre-service science teachers' conceptual understandings of electrochemistry at the University of Ghana. *African Journal of Chemical Education (AJCE)* 11(2), 129-147.
- Bandura, A. (1982). Self-efficacy Mechanism in Human Agency. *American Psychologist*, 37(2), 122147.
- Daryanto. (2010). *Media Pembelajaran Peranannya Sangat Penting dalam Mencapai Tujuan Pembelajaran*. Yogyakarta : Gava Media

- Greene, J. A., Daniel C. Moos, and Roger Azevedo. (2011). Self-Regulation of Learning with Computer-Based Learning Environments. *New Directions for Teaching and Learning*, No. 126: 107-115
- Lightbody, G., P. McCullagh, M. Hutchison, and C. Weeks. (2006). The Supporting Role of Emerging Multimedia Technologies in Higher Education. *7th Annual Conference*. 46-54
- Nazir, M. I. J., Aftab Haider Rizvi, Ramachandra V Pujeri. (2012). Skill Development in Multimedia Based Learning Environment in Higher Education : An Operational Model. *International Journal of Information and Communication Technology Research*, 2(11), 820-828
- Osamah, M., S. F. Fong, and W. Zaid. (2010). Effects of Multimedia-based Instrucyional Designs for Arabic Language Learning among Pupils of Different Achievement Levels. *International Journal of Human and Social Science* : 311-317
- Retno Dwi Suyanti. (2010). *Evaluasi Hasil Belajar Kimia*. Yogyakarta: Graha Ilmu
- Turan, S., and Özcan Demirel. (2010). The Relationship Between SelfRegulated Learning Skills and Achievement : A Case from Hacettepe University Medical School. H. U. *Journal of Education*, No. 38: 279-291
- Zimmerman, B.J. (1989). A Social Cognitive View of Self-Regulated Academic Learning. *Journal of Educational Psychology*, 329 – 339
- Zimmerman, B.J., Sebastian Bonner, and Robert Kovach. (1996). *Developing Self-Regulated Learners Beyond Achievement to Self-Efficacy*. USA: American Psychological Association.
- Zumbrunn, S., Joseph Tadlock and Elizabeth Danielle Roberts. (2011). *Encouraging Self-Regulated Learning in Classroom : A Review of The Literature*. Virginia: Metropolitan Educational
- Research Consortium (MERC) Erfan P., Sulistyani. (2014). *Journal of Education and Learning*. Vol.8 (4) pp. 363-367.