Effects of Blended Learning towards Students' Performance in Electrochemistry Topic among Secondary School Students in Malaysia

Mohd Ariffuddin Abdul Aziz, Othman Talib, Tajularipin, Sulaiman and Nurzatulshima Kamarudin

Effects of Blended Learning towards Students' Performance in Electrochemistry Topic among Secondary School Students in Malaysia

Mohd Ariffuddin Abdul Aziz, Othman Talib, Tajularipin, Sulaiman and Nurzatulshima Kamarudin

Faculty of Educational Studies, University Putra Malaysia, 43400 UPM Serdang, Selangor Malaysia.

Abstract

The study aimed to investigate the effectiveness of blended learning towards students' performance in Electrochemistry topic among Malaysian secondary school students. A quasi-experimental study was carried out at one of the secondary schools located in Hulu Langat District, Selangor, Malaysia. The respondents in this study were 62 students that comprises of 31 respondents in blended learning group and 31 respondents in traditional learning group. The research design in the current study employed a quasi-experimental with a nonrandomized control group with pre-test and post-test. The instrument used in this study was based on previous Sijil Pelajaran Malaysia (Malaysia Education Certificate). The data was analyzed in inferential statistics which encompasses pair sample t-test and independent sample t-test. The findings of this study revealed that blended learning and traditional learning had improved students' performance in Electrochemistry topic. However, there was a significant difference on the mean scores of the electrochemistry performance post-test between the blended learning group (M=75.5484, SD = 8.84247) and the traditional learning method group (M=47.0000, SD= 7.43416); (t (60) =13.759, p = 0.00) (p<0.05). The findings in this study revealed that blended learning is more effective than traditional learning method in order to improve students' performance in Electrochemistry topic. The researcher suggested that blended learning should implemented to other subjects and the policy maker should adopt blended learning instruction in education curriculum.

Keyword: Blended learning, Quasi Experimental, Performance in Electrochemistry.

Introduction

Over the past two decades, the development of internet technology and communication (ICT) had influenced the education system around the world. This was a wake up call among the curricula experts and educational institutes to revise and introduce the changes in policy and

educational planning to respond of the changes in education system due to the development of internet technology (Choshin & Ghaffari, 2017). In Malaysia, according to Malaysia Education Blueprint 2013-2025, at the 7th shift, to leverage the ICT in order to scale up the quality of learning across Malaysia. The Ministry of Education in Malaysia has provide the internet access to 10000 schools in Malaysia, augment the online learning content through the sharing by experts teachers and maximize the uses of ICT for distance and self-pace learning to expand access for high quality of teaching. The students were exposed to online learning as a new pedagogical method to improve the quality of teaching. The involvement of advancement information communication and technology in instructional is known as online learning which consisted of electronic media (Thomas & Graham, 2019).

Recently, the uses of internet technology to support the education become popular among the teachers in order to enhance the quality of pedagogy by implementing the combination of online learning and classroom learning. According to Graham (2013), blended learning is an instructional with an integration between the online learning and face-to-face learning. The implementation of blended learning become popular among the educators due to the development of ICT in education. However, blended learning is not simply to replace the conventional learning with integration of ICT. A blended learning instruction should be representing for fundamental in conceptualizing and reorganizing for dynamic teaching and learning to incorporate various teaching components such as online learning, face-to-face learning, media for learning contents, synchronous and asynchronous interaction, different of teaching materials and activities for groups or individuals (Garrison & Kanuka, 2004; Hoic-Bozic, Mornar, & Boticki, 2009).

The integration of online learning using the computer and face-to-face classroom learning may enhance the students' interest to learn as well as to motivate them in achieving the goal in education. The teaching materials such as videos, notes, online learning discussion, and online quizzes in the online learning platform could improve the students' ability to comprehend the topic taught by the teachers. The combination of multimedia in teaching and collaborating among the students are some of the effective techniques to help the students' in order to master the lesson as well as improving their performance in academic (Asparin & Tan, 2018). The participation of students in the online learning discussion could make the instructional become more effective and enhance the active learning among them. In classroom learning session, the students will discuss the topic with the teacher and peers to improve their understanding for the particular subject. In addition, the students will be more active in the classroom, students will be more creative during the instructional, better prepared and more interesting because blended learning provides the various teaching materials and resources for the students (Susan & Chris 2015).

There are several features of blended learning, which help the students in learning process. According to Driscoll (2002); Graham (2006); Whitelock and Jelfs (2003), the features of blended learning are summarized as follows:

i) The strategy used in blended learning was combined with different types of technology which based on internet in order to achieve the goal in education.

ii) The blended learning is considered as combination between instructional with technology and face-to-face traditional method.

iii) There are multiple theories such as constructivism and behaviorism involved in teaching method for the blended learning

iv) Blended learning consists of in-person classroom time and individual study using the online learning through applying the internet technology.

Educators are eager to implement blended learning in their instructions due to several aspects such as the richness of pedagogy in blended learning, the efficiency of learning strategy in blended learning, easier in accessing knowledge for students during the lesson, relevant cost in implementing blended learning and the easiness of innovation in the instructional (Osguthorpe & Graham, 2003).

Electrochemistry is one of the topic in the form four chemistry syllabus in Malaysia curriculum. This chapter is at 6th chapter in the form four chemistry textbook. Electrochemistry is a study about changing between chemical energy and electrical energy which encompasses electrolysis and voltaic cells (Tan et al. 2007). According to Johnstone (1993), students are required to understand three levels in chemistry namely as macroscopic, microscopic and symbolic. At macroscopic level, students are required to comprehend the changes in electrolysis and voltaic cell during the redox process occurred at the electrodes. For the microscopic level, the students are required to imagine the movement of electrons at the circuit, the flows of ions in the electrolyte and the changes occurred at the electrodes. At the symbolic level, students are required to write chemical equation and stated the substance produced through the chemical reactions. However, according to Finley, Stewart and Yarroch (1982), electrochemistry is a difficult topic to teach and learn by the students. Students felt confused for the topic of electrolysis process due to the difficulty in assimilating their knowledge across physic and chemistry (Taber, 1998). Several researches revealed that students are facing misconception in differentiate the electrical flows in electrolytes and metal conductor (Sanger & Greenbowe, 1997; Allsop & George, 1982; Karsli & Çalik, 2012).

The researcher comes with a blended learning in order to improve students' performance in electrochemistry topic. In this experimental study, there are two research objectives proposed by the researcher:

i) To determine whether there are differences of performance in electrochemistry topic among the students in blended learning group and traditional learning group.

Ho1: There is no significant difference of electrochemistry topic performance at the pre-test level between the blended learning group and traditional learning group.
Ho2: There is no significant difference of electrochemistry topic performance at the post-test level between the blended learning group and traditional learning group.

ii) To determine whether there are differences of performance in electrochemistry topic between the pre-test level and post-test level among the students in blended learning group and traditional learning group.

Ho3: There is no significant difference of performance in electrochemistry topic at the pre-test level and post-test level among the students in blended learning group.

Ho4: There is no significant difference of performance in electrochemistry topic at the pre-test level and post-test level among the students in traditional learning group.

Literature Review
There are numerous of study had been carried out about the effectiveness of blended learning to improve students' performance in education. However, according to Ashikin and Osman (2013), study about the blended learning on chemistry subject at the secondary school level is still lack in Malaysia due to the minimum number of teachers used the online learning platform. Previous studies had showed the effectiveness of blended learning in order to improve students' performance.

A study about the blended learning conducted by Al-Qahtani and Higgins (2013), showed that students who were exposed with blended learning group showed the highest achievement compared to e-learning and traditional learning method. In this study, the researchers had investigate the three different of instructional in order to improve students' achievement in academic. The findings revealed that there was no significant different when comparing the e-learning and traditional learning. However, the blended learning results showed the positive effects on students' achievement.

In addition, a study conducted by Alsalhi, Eltahir, and Al-Qatawneh (2019), revealed that blended learning had a potential to improve students' achievement in science as well as their attitude. The study was conducted among 112 nine-grade students located in United Arab Emirates. The results of the study showed that there was a significant different on academic achievement in science subject and attitude of the students between the experimental group and traditional learning group. The researchers had suggested to implement blended learning among the university students for the further studies.

Moreover, a study about the effects of blended learning towards the students' academic achievement and practical skills in science laboratories among the university students conducted by Hinampas et al (2018), showed that the blended learning had a positive impact on practical skills in science laboratories among the students. Even though there was no significant different for academic achievement among the students between the blended learning group and traditional learning group. The researchers suggested for further investigation on blended learning towards the combining learning strategies as well as assessing the students' academic outcomes.

On the other hand, there were several researches contrary about the effectiveness of blended learning in order to improve students' achievement. A research conducted by Chang, Shu, Liang, Tseng, and Hsu (2014), revealed that blended learning had no significant different for the electrical machinery performance among the students in blended learning group and traditional learning method group. The findings were in line with a study conducted by Elmer, Carter, Armga, and Carter (2016) which revealed that blended learning did not compromise students' performance in physiological education among the university students.

Research Methodology
The research design in the current study employed a quasi-experimental with a nonrandomized control group with pre-test and post-test. The study only implement for quantitative method in

order to determine the effects of blended learning towards the performance of students in electrochemistry topic. However, a pilot study was done before conducting the real study to test the designed of blended learning approach, improving the teaching materials in online learning platform and checked the reliability of the instrument. The classes involved in this study was structured by the administration of the school. As consequences, due to the difficulty of randomized the students in the school, two intact-classes were chosen to conduct the study. According to Creswell (2012), due to the educational setting, the researcher require to implement intact groups in experimental study because of availability of respondents or because of setting hinders forming the artificial group. Quasi-experimental design is considered a suitable research design when intact classroom are selected for treatment group and control group (Ary et al., 2014).

Table 1: Nonrandomized Control Group, Pretest-Posttest Design

Group	Pre-test	Treatment	Post-test
experimental	O1	X	O2
control	O2	-	O2

X = Intervention (Blended Learning)
O= Measurement of dependent variable

In this study, purposive nonprobability sampling procedure was implemented in order to choose the blended learning group and traditional learning group. In purposive sampling, the respondents in the study were chosen based on the belief that they are representative for the population. The researcher had assigned the blended learning group and traditional learning group randomly to reduce the threat of internal validity through applying coin-flipping technique. There were 62 respondents involved in this study among the form four chemistry students, which encompasses two different classes from one of the secondary school, located in Ampang, Selangor. There were 31 respondents in blended learning group and traditional learning method group respectively. The instruments used in this study is to measure students' performance in electrochemistry was prepared based on previous chemistry questions in Sijil Pelajaran Malaysia (Malaysia Certificate of Education) and comprises of three sections namely as multiple questions, structured questions and essay questions. The duration for the test is 1 hour and 30 minutes.

The duration of the study was within eight weeks. In the first week, the respondents in the both groups were given pre-test to ensure their equivalence in terms of performance in electrochemistry topic before implementing the treatment. In week two until week seven, the respondents learned about the electrochemistry topic. For the blended learning group, the respondents were taught using the combination of online learning and face-to-face learning while the traditional learning group only used the face-to-face learning method. The researcher had prepared the teaching materials in the online learning platform such as videos, notes, quizzes, online discussion and online task. In this study, google classroom was used as the online learning platform to the respondents in the blended learning group. The respondents in blended learning group were taught with the online learning session at the school computer laboratory followed by face-to-face learning at chemistry laboratory while the traditional learning group was only taught at the chemistry laboratory. For the face-to-face learning session, the students were

exposed to the group presentation, group discussion and laboratory experiments. At week eight all the respondents were given post-test to investigate the effectiveness of blended learning and traditional learning on performance in electrochemistry topic.

The data was analyzed using the inferential statistic through pair sample t-test and independent sample t-test. Pair sample t-test was used to determine mean difference for the two-repeated measure in one group while the independent sample t-test was used to determine mean difference of two different group (Chua, 2006). The researcher had conducted Exploratory Data Analysis (EDA) before implementing the para-matrix data analysis to check the data normality.

Findings

Ho1: There is no significant different of electrochemistry topic performance at the pre-test level between blended learning group and traditional learning group.

In order to investigate the homogeneity between the blended learning group and traditional learning group in term of performance in electrochemistry topic before carrying out the research. An independent sample t-test was employed to compare mean scores at the pre-test level between blended learning group and traditional learning method group.

Table 2: Independent Sample T-test Result for the mean Pre-test Scores of Electrochemistry Performance

Group	N	Mean	Standard Deviation	t	df	Sig	Mean Difference
Blended Learning	31	8.5161	3.03173	-.041	60	.967	-.03226
Traditional Learning	31	8.5484	3.17111				

As shown in Table 2, there was no statistically significant difference on the mean scores of the electrochemistry performance pre-test between the blended learning group (M=8.5161, SD = 3.03173) and the traditional learning method group (M=8.5484, SD= 3.17111); (t (60) =-0.041, p = 0.967) (p>0.05). The difference of mean's score at the pre-test level between the blended learning and traditional learning group was -.03226. This indicated that fail to reject the null hypothesis. The findings of the independent sample t-test indicated that both group were equivalent in term of electrochemistry performance before implementing of the treatment.

Ho2: There is no significant difference of electrochemistry topic performance at the post-test level between blended learning group and traditional learning group.

In order to investigate the differences of electrochemistry topic performance at the post-test level between blended learning group and traditional learning group, an independent sample t-test was employed to compare mean scores at the post-test level between blended learning group and traditional learning method group.

Table 3: Independent Sample T-test Result for the mean Post-test Scores of Electrochemistry Performance

Group	N	Mean	Standard Deviation	t	df	Sig	Mean Difference
Blended Learning	31	75.5484	8.84247	13.759	60	.000	28.54839
Traditional Learning	31	47.0000	7.43416				

As shown in Table 3, there was statistically significant difference on the mean scores of the electrochemistry performance post-test between the blended learning group (M=75.5484, SD = 8.84247) and the traditional learning method group (M=47.0000, SD= 7.43416); (t (60) =13.759, p = 0.00) (p<0.05). The difference of mean's score at the post-test level between the blended learning and traditional learning group was 28.54839.This indicated that null hypothesis was rejected. Therefore, respondents in blended learning group showed the higher scores in electrochemistry performance at the post-test level than respondents in traditional learning group.

Ho3: There is no significant difference of performance in electrochemistry topic at the pre-test level and post-test level among the students in blended learning group.
In order to investigate the differences of electrochemistry topic performance at the pre-test level and post-test level in blended learning group, a pair sample t-test was employed to compare mean scores between the pre-test level and post-test level in blended learning group.

Table 4: A Pair Sample T-test Result between the Mean of Pre-test Scores and Post-test Scores in Blended Learning Group.

Blended Learning	N	Mean	Standard Deviation	t	df	Sig	Mean Difference
Pre-test	31	8.516	3.0317	-45.094	30	.000	-67.03226
Post-test	31	75.5484	8.84247				

As shown in Table 4, there was statistically significant difference on the mean scores of the electrochemistry performance between the pre-test level (M=8.516, SD =3.0317) and post-test level (M=75.5484, SD =8.84247) in blended learning group (t= -45.094, df=30, p<0.05). The difference of mean's score was -67.03226. This indicated that null hypothesis was rejected. Therefore, students in blended learning group showed the higher scores in electrochemistry performance at the post-test level than pre-test level. This indicated that the level of electrochemistry performance of the respondents had improved after studying using the blended learning method.

Ho4: There is no significant different of performance in electrochemistry topic at the pre-test level and post-test level among the students in traditional learning group.
In order to investigate the differences of electrochemistry topic performance at the pre-test level and post-test level in traditional learning group, a pair sample t-test was employed to compare mean scores between the pre-test level and post-test level in traditional learning group.

Table 5: A Pair Sample T-test Result between the Mean of Pre-test Scores and Post-test Scores in Traditional Learning Group.

Traditional Learning	N	Mean	Standard Deviation	t	df	Sig	Mean Difference
Pre-test	31	8.5484	3.17111	-25.566	30	.000	-38.45161
Post-test	31	47.0000	7.43416				

As shown in Table 5, there was statistically significant difference on the mean scores of the electrochemistry performance between the pre-test level (M=8.5484, SD =3.17111) and post-test level (M=47.0000, SD =7.43416) in traditional learning group (t=-25.566 , df=30, p<0.05). The difference of mean's score was -38.45161. This indicated that null hypothesis was rejected. Therefore, students in traditional learning group showed the higher scores in electrochemistry performance at the post-test level than pre-test level. This indicated that the level of electrochemistry performance of the respondents had improved after studying using the traditional learning method.

Discussion

The purpose of this study is to investigate the effects of blended learning towards students' performance in Electrochemistry topic among the form four secondary school students. The findings revealed that both blended learning and traditional learning method showed the positive effects on students' performance in Electrochemistry topic. However, the results showed that there was a statistically significant difference on students' performance in Electrochemistry topic between the blended learning group and traditional learning method group, where the students in blended learning group have significantly higher scores than the traditional learning method group. The findings in this study was in line with a study conducted by Khader (2016) which stated that the students in blended learning showed higher achievement in the examination when compared to students in traditional learning group. Similarly, to a study conducted by Alsalhi, Eltahir, and Al-Qatawneh (2019), revealed that students in the blended learning group showed higher scores in science subject than the traditional learning group. The findings in the current study demonstrated that blended learning has a potential to improve students' performance in Electrochemistry topics among the secondary school students.

The main reason to advocate for blended learning method is to enhance students' performance using teaching materials provided in the online learning platform. The teaching materials such as videos, notes, online quizzes and online task enhancing the students to comprehend the topic of Electrochemistry through the multimedia and animation elements in the videos as well as the online tasks which is engaging for students to develop and constructing new ideas. The blended learning method also provides the opportunities for the students to comprehend the lesson as well as to extend the knowledge of the students (Cooner, 2010). The blended learning environment promotes active learning among the students when the students were involved in online discussion as well as participating activities in the classroom learning. The findings was in line with the findings by Nizal, Shaharanee, and Jamil (2016), that the online learning as an effective learning environment to provide an active learning among the students due to the taking part through the online discussion.

The combination between the online learning and face-to-face learning enhance the students in understanding the topic that was taught by the teacher. When the students had learned in the classroom learning, then followed by the online learning session, the students become more comprehend and mastered the topic. In addition, blended learning also provides constructivism-learning environment among the students through creating curiosity as well as developing new ideas by relating students' prior knowledge during studying online learning and taking part in the classroom learning activities. The findings was in line with a study Harvey and Chris (2001), which revealed that blended learning is combination of pedagogical approaches such as constructivism, behaviorism as well as cognitivism to enhance the education goals.

Conclusion

The findings in the current study revealed that blended learning was an effective method to improve students' performance in Electrochemistry topic. However, the scores among the students in both blended learning group and traditional learning method had improved at the end of the treatments. As recommendations, blended learning should be adopted in order to teach electrochemistry topic. The researchers also suggested to implement blended learning to other topics in the chemistry subject. The policy maker should implement the blended learning in education curriculum while the teacher should practice blended learning in their instruction due to the development of ICT in education around the world which affected the humans' life style. The implementation of internet technology in education could enhance the students' motivation, interest in learning as well as improving the teaching skills among the teachers. Further studies are required in order to discover the effectiveness of blended learning towards the other science subjects such as biology and physic or other subjects as well. In addition, research about the blended learning by combining with other difference approaches should be investigated in order to improve the quality of education as well as the performance of students.

Corresponding Author
Mohd Ariffuddin Abdul Aziz
Faculty of Educational Studies, University Putra Malaysia
Email: mohd.ariffuddin84@gmail.com

References

Allsop, R. T., & George, N. H. (1982). Redox in Nuffield advanced chemistry. *Education in Chemistry* 19: 57-59.

Al-Qahtani, A. A. Y., & Higgins, S. E. (2013). Effects of traditional, blended and e-learning on students' achievement in higher education. *Journal of Computer Assisted Learning*, 29(3), 220-234.

Alsalhi, N. R., Eltahir, M. E., & Al-Qatawneh, S. S. (2019). The effect of blended learning on the achievement of ninth grade students in science and their attitudes towards its use. *Heliyon, 5*(9), e02424. https://doi.org/10.1016/j.heliyon.2019.e02424

Ary, D., Jacobs, L. C., Sorensen, C. K., & Walker, D. (2014). *Introduction to research in education* (9th ed.). Wadsworth, Cengage Learning.

Ashikin, I., & Osman, K. (2013). Kesan Frog VLE Secara Pembelajaran Kooperatif Terhadap

Pencapaian, KBAT dan Minat Pelajar Bagi Subjek Kimia. *Fakulti Pendidikan, Universiti Kebangsaan Malaysia*, 635–649.

Asparin, A. A., & Tan, D. A. (2018). Students' Problem Solving Skills in Enhanced Gradual Release of Responsibility Instruction Model. *Asian Academic Research Journal of Multidisciplinary*, 5(3), 121-128.

Choshin, M., Ghaffari, A. (2017). An investigation of the impact of effective factors on the success of e-commerce in small-and medium-sized companies. *Comput. Hum. Behav*. 66, 67–74.

Creswell, J. W. (2012). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research* (4th ed.). Boston, MA: Pearson Education.

Cooner, T. S. (2010). Creating opportunities for students in large cohorts to reflect in and on practice: Lessons learnt from a formative evaluation of students' experiences of a technology-enhanced blended learning design. *British Journal of Educational Technology*, 41(2), 271–286. https://doi.org/10.1111/j.1467-8535.2009.00933.x

Driscoll, M. (2002). Blended Learning: Let's Get beyond the Hype. IBM Global Services. Retrieved from: http://www-07.ibm.com/services/pdf/blended_learning.pdf

Elmer, S. J., Carter, K. R., Armga, A. J., & Carter, J. R. (2016). Blended learning within an undergraduate exercise physiology laboratory. *Advances in Physiology Education*, 40(1), 64-69.

Finley, F. N., Stewart, J., & Yarroch, W. L. (1982). Teachers' perceptions of important and difficult science content. *Science Education*, 66, 531-538.
http://dx.doi.org/10.1002/sce.3730660404

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet and Higher Education*, 7,95–105.
https://doi.org/10.1016/j.iheduc.2004.02.001.

Graham, C. R. (2006). *Blended learning systems: definition, current trends, and future directions*. In: Bonk, C.J., Graham, C.R. (Eds.), Handbook of Blended Learning: Global Perspectives Local Designs. Pfeiffer Publishing, SanFrancisco, CA, pp. 3–21.

Graham, C. R. (2013). *Emerging practice and research in blended learning*. In M. G. Moore (Ed.), Handbook of distance education, (3rd ed., pp. 333–350). New York: Routledge.

Harvey, S., Ve Chris, R. (2001). A White Paper: Achieving Success with Blended Learning. 21.01.2015. http://www.centra.com/ download/whitepapers/blendedlearning.pdf .

Hinampas, R. T., Murillo, C. R., Tan, D. A., & Layosa, R. U. (2018). Blended learning approach: Effect on students' academic achievement and practical skills in science laboratories. *International Journal of Scientific and Technology Research*, 7(11), 63–69.

Hoic-Bozic, N., Mornar, V., & Boticki, I. (2009). A Blended Learning Approach to Course Design and Implementation. *IEEE Transactions on Education, 52(1), 19–30.* doi:10.1109/te.2007.914945

Karsli, F., & Çalik, M. (2012). Can freshman science student teachers' alternative conceptions of 'electrochemical cells' be fully diminished? *Asian Journal of Chemistry,* 24(2): 485-491.

Khader, N. S. K. (2016). The Effectiveness of Blended Learning in Improving Students' Achievement in Third Grade's Science in Bani Kenana. *Journal of Education and Practice*, 7(35), 109–116. Retrieved from
http://libproxy.library.wmich.edu/login?url=https://search.proquest.com/docview/18959

79064?accountid=15099

Nizal, I., Shaharanee, M., & Jamil, J. M. (2016). Google classroom as a tool for active learning. *AIP Conference Proceedings* 1761, 020069 (2016); doi: 10.1063/1.4960909

Sanger, M. J., & Greenbowe, T. J. (1997). Common student misconceptions in electrochemistry: Galvanic, electrolytic, and concentration cells. Journal of Research in Science Teaching 34(4): 377-398.

Susan, P., Chris, S. (2015). Maximising Competency Education and Blended Learning. Incol Competency Works, New York.

Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. The Quarterly Review of Distance Education,4 (3), 227 – 233.

Taber, K. S. (1998). The sharing-out of nuclear attraction: Or "I can`t think about physics in chemistry". International Journal of Science Education, 20, 1001-1014. http://dx.doi.org/10.1080/0950069980200807

Tan, Y. T., Loh, W. L., & Tan, O. T. (2007). *Success Chemistry SPM*. Shah Alam: Oxford Fajar Sdn. Bhd.Aziz, M. A. A., Talib, O., Tajularipin, Sulaiman, & Kamarudin, N. (2021). Effects of Blended Learning towards Students' Performance in Electrochemistry Topic among Secondary School Students in Malaysia. *International Journal of Academic Research in Progressive Education and Development*, *10*(2), 1-.

Thomas, J., Graham, C. (2019). Online teaching competencies in observational rubrics: What are institutions evaluating? *Distance Educ*. 40 (1), 114–132.

Whitelock, D., Jelfs, A. (2003). Editorial: journal of educational media special issue on blended learning. *J. Educ. Media* 28 (2-3), 99–100.