JTVE, Special Edition NARTC 2024, Vol 9, No 2 (2024)
eISSN: 0128-0821
http://upikpolimas.edu.my/ojs/

The Effectiveness of Blended Learning for Engineering Mathematics

Normah Adnan, Che Rogayah Desa, Nor Azuana Taib,
Azora Jaafar, Siti Rohanah Murad, Zainab Abdullah
Department of Mathematics, Science and Computer, Politeknik Sultan Abdul Halim Muádzam Shah,
06000 Bandar Darulaman, Jitra Kedah Malaysia

Abstract: E-learning is one of the digital learning skills in technical and vocational education training (TVET) systems. Adapting classroom interactions and online instructions became necessary to enhance students' experience in mastering a subject and improve teaching methods. This study was conducted to investigate the factors that influence the effectiveness of blended learning as a teaching method to increase student interest in the subjects. The respondents chosen are 30 students of semester 2 for DBM20023 Engineering Mathematics 2 in Politeknik Sultan Abdul Halim Muádzam Shah. The questionnaire was used to collect data from respondents that consisted of three aspects; (1) learning aids requirement, (2) digital skills efficiency, and (3) the use of e-learning in education. The findings of this study suggest that blended learning significantly improves student interest by providing an attractive content delivery and a good presentation design. It also found that the integration of TVET and e-learning is an effective way to be used for the teaching and learning process which benefits both students and lecturers. Thus, e-learning provides potential contributions to enhance teaching skills and as a future learning style in line with the TVET era.

Keywords: *Blended learning, e-learning, teaching methods, TVET*

1.0 INTRODUCTION

Technical and vocational education and training (TVET) is a crucial component of Malaysia's education plans. TVET plays a significant contribution between academia and industry practitioners to provide a skilled workforce. The Malaysia Education Blueprint 2015-2025 (Higher Education), specifically highlights the importance of TVET in producing talented individuals with specialized skills to meet a knowledge-based economy. As a higher education institution in Malaysia, Polytechnics outlined a strategic plan to equip students with expertise not only in technical competencies but also in digital technology (*Jabatan Pendidikan Politeknik dan Kolej Komuniti*).

E-learning is one of the digital skills that has been implemented in the TVET curriculum. The focus point of e-learning is to ensure and provide flexibility and convenience learning (Haron, Abbas, & Rahman, 2012; Hodges et al., 2020). It offers numerous benefits that make learning more accessible, engaging, and effective. Students can access course materials, participate in discussions, and complete assignments at their own pace and from any location with an internet connection. Moreover, the combination of classroom interactions and live instructions became more meaningful which allows them to suit their learning environment (Dzakiria, A. Wahab, and Rahman, 2012; Firman, 2020). According to Wu & Patel (2016), integration of blended learning in modern education shows a positive cognitive result among the students. Students can adjust the pace of instruction, revisit challenging concepts, and access supplementary resources to improve knowledge retention.

The challenges in the context of TVET and e-learning need to be addressed deeply. The acceptance of implementing e-learning still requires support from students and educators due to the lack of e-learning optimization by students. Therefore, this study aims to investigate the effectiveness of blended learning in educating the student's interest in the online learning revolution using the Curriculum Information Document Online System (CIDOS). Respondents are in semester 2 and taking the subject of Engineering Mathematics. A total of 30 students are chosen to answer the questionnaire. The questionnaire was used to collect data that consisted of three aspects; (1) learning aids requirement, (2) digital skills efficiency, and (3) the use of eLearning in education. The findings can fill the limitation of integrating e-learning in TVET education to improve student interest and motivation in the learning process. This is also a significant way to facilitate learning, access, and manipulate information that benefits students and lecturers in the TVET era.

2.0 LITERATURE REVIEW

The integration of e-learning in TVET education is crucial for preparing Generation Z (Gen Z) which includes individuals born between 1997 and 2013. This aligns with Wang and Kang (2006), who founded cybergogy learning approach that promotes the involvement of students in learning using digital technology. In the advance of communication and information technology (ICT), online teaching and learning are particularly well-suited for Gen Z (Hussin, 2018). This is supported by Islam Sarker et al., 2019, Ødegaard et al., 2021 and Amin & Sundari, 2020 that by leveraging digital technology and adopting a cybergogy learning approach, educators can enhance educational outcomes and provide students with the necessary skills. This opinion is corroborated by the study of Yu (2020), where the results indicate that Gen Z students are more prefer to communicate towards a flexible and accessible schedule that allows them to manage their learning independently.

TVET in conjunction with the Industrial Revolution 4.0 (4IR), e-learning has experienced significant growth in its ability to enhance educational outcomes and prepare students for the demands of the modern workforce. It is important to note that the different categories of e-learning techniques in education have been initiated by several changes as shown in Figure 1.

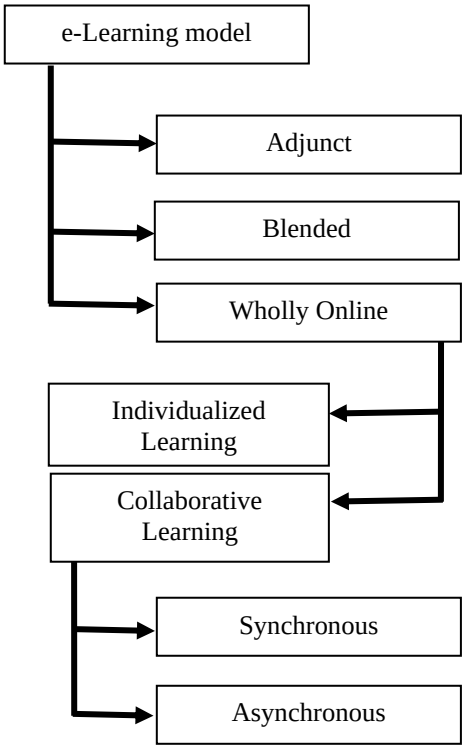

***Figure 1**: e-learning Model*

Figure 1 shows the model of e-learning that can be used. Lecturers can employ any technique or all the techniques that suit the group of learners. For example, the adjunct technique can be used in a traditional classroom that provides relative independence to learners. Meanwhile, blended e-learning delivered the course materials using traditional learning and e-learning methods. In blended learning, the multimedia elements are important in keeping students engaged and motivated throughout the learning process. Wholly online learning is divided into two divisions which are individualised and collaborative learning that is devoid of traditional learning or classroom participation.

Adapting the ADDIE model, introduced by Rosset in 1987, is very useful in developing instructional strategies. Various educationists have applied this model in developing teaching-leaning activities (Gure, 2019; Zulkifli et.al., 2018; Alnajdi, 2018). This model is a generic model that provides an easy-to-understand nature (F. Hishamudin, 1997). The ADDIE model is shown in Figure 2.

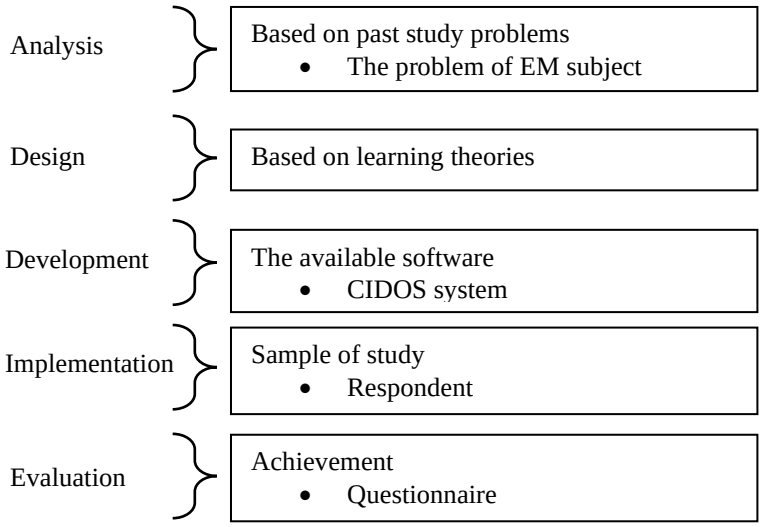

***Figure 2**: ADDIE model*

ADDIE model contains five (5) phases, which are analysis, design, development, implementation, and evaluation (Nasohah et.al., 2015). Firstly, the analysis based on the related subject is carried out to cater to the problem. In this study, the subject of engineering mathematics (EM) is selected. The next phase is to design the learning activities. The activities are based on learning theories such as visuals and graphics including animation, text, video, and audio to attract student motivation. The adaptation of multimedia elements mostly gains popularity among students. The development the storyboards is then created which refer to the subject that consists of the sections of the course outline, notes, quizzes, assignments, and tests. However, users are required to log in using their identification details (ID) and password by filling in their matric number and enrolment key. The sample of the study is used for the implementation phase. The results collected from a questionnaire respondent after the use of the application is evaluated.

As a summary from the literature reviews, the hypothesis proposed is "*there is a significant relationship between teaching methods and the effectiveness of blended learning*.". Therefore, this study used the ADDIE model to carried out is beneficial for educators to encourage a mixture of teaching methods to attract student interest. It is education without boundaries, which is at anytime and anywhere the teaching and learning process is free.

3.0 METHODOLOGY

The main instrument in this study is Phases D and E. A set of questionnaires form are distributed to respondents. The strength of the questionnaire depends on interesting questions that can encourage respondents to answer it completely and honestly (S. Rajasekar et. al., 2006). The questionnaire is divided into two parts which are part A points on the respondent demographics and part B is design related to the problem that collected from Phase A. Respondents are required to circle one answer from the five (5) scale choices to the questions. The information obtained from the questionnaire was then analysed to answer the research questions. 30 respondents from the semester 2 class are taking the subject of Engineering Mathematics at Polytechnic Sultan Abdul Halim Muádzam Shah (POLIMAS).

The usability of the CIDOS is evaluated among students using questionnaires. The achievement is collected from information obtained from a questionnaire respondent after the use of the application. The questionnaires consisted of Part B which focused on three sections of the usability evaluation: learning aids requirement, digital skills efficiency and the use of e-learning in education. Respondents'

responses were based on a Likert scale score: namely, 1 = strongly disagree (SD), 2 = disagree (D), 3 = less agree (LA), 4 = agree (A), and 5 = strongly agree (SA) as shown in Table 1. The usability of this system was analysed using answers scales of 4 and 5 points to get the percentage level using Microsoft Excel.

Table 1: Likert scale score

Scale	Score
1.	Strongly Disagree
2.	Disagree
3.	Less Agree
4.	Agree
5.	Strongly Agree

Data analysis is then made using the mean score. The mean score for measuring the response rate from the respondents was classified into three mean score scores with three levels namely high, medium and low as shown in Table 2. The data were recorded and processed using Microsoft Excel.

Table 2: Mean score

Score	The level of agreement
2.68 to 4.00	High
1.34 to 2.67	Medium
0.00 to 1.33	Low

4.0 DATA ANALYSIS AND FINDINGS

The findings were obtained through a set of questionnaires distributed to the respondents. This quantitative data was analysed using Excel software. Overall analysis of the findings related to the e-learning application using descriptive analysis. Analysis of the findings is presented in the form of frequency tables.

4.1.1 Analysis of the Findings of Part A

The information from respondent demographics is presented in Table 3. The data collected are important to conduct the studies.

Table 3: Respondents distribution by gender

Gender				
Demographic	Frequency	Percentage	Valid percentage	Cumulative Percentage
Male	10	33.3	33.3	33.3
Female	20	66.7	66.7	100
Total	30	100	100	

From Table 3, the studies conducted involved different sexes of 30 respondents are involved of male students 33% and 67% were female students. The majority were aged 19 years. This condition identifies that the abilities and readiness of the students to accept the development of e-learning model.

4.1.2 Analysis of the findings of Questionnaire – Part B.

The questionnaires of Part B are focused on three dimensions of the usability evaluation: learning aids requirement, digital skills efficiency and the use of e-learning in education. The findings of the efficiency of teaching aids needed in the Engineering Mathematics (EM) subject are presented in Table 4.

Table 4: Learning Aids requirement in Engineering Mathematics subject

Learning Aids Requirement	N	Mean	Standard deviation
I enjoy learning the subject of Engineering Mathematics.	30	5.00	.000
I am more excited if learning comes with learning aids.	30	5.00	.000
I need learning aids in the subject of Engineering Mathematics.	30	4.56	.490
I do not understand if lectures only use module books and printed materials	30	4.45	.759
I need reference materials when studying alone	30	4.55	.510

According to Table 4, the overall mean shows a high score of 4.00 out of 5. It explains that students need teaching aids to understand the EM subject, especially when they are studying at home. Students are more excited to learn if they have a reference for self-learning or repeated learning.

As a result, data from Table 4 with regard to learning aids and the problem related to the subject are carried out by the survey data as indicated in Table 5.

Table 5: E-learning skills in understanding the topic

Digital Skills Efficiency	N	Mean	Standard deviation
I can collaborate with peers on content that is related to assignments or projects.	30	2.30	.470
I prefer to use interactive digital tools to understand the topic and complete the learning process.	30	2.55	.510
I am skilled in online learning resources to enhance learning experience?	30	3.40	.503
I often use digital tools to create presentation slides in learning activities.	30	2.05	.686
I need emerging technologies in my study to support the learning process.	30	3.65	.489

As shown in Table 5, the functionalities of learning aids and reference materials when studying alone related to the subject show the mean score of the use of interactive digital tools to understand the topic and complete the learning process on the topic is 2.55 while the mean value of learning emerging technologies is 3.65.

Consequently, the next section is intended to determine the effectiveness of e-learning skill. The information in the e-learning content is suitable to facilitate the learning process. The 5 related questions to be answered by the respondent. Table 6 shows the findings from the questionnaires that have been conducted.

Table 6: Findings of effectiveness in terms of information design in e-learning

Use of eLearning Education	N	Mean	Standard deviation
I would be able to use online educational tools even if there is no one around to tell me how to use them.	30	4.467	.639
The information presented is easy to understand?	30	4.400	.674
The delivery of content is organized and in line with the topics presented.	30	4.300	. 621
Content delivery speed according to user capabilities?	30	4.400	. 651
Content delivery can attract students' interest.	30	4.133	. 776

From Table 6, the information on e-learning is delivered on the selected topic of content presented by the mean value and standard deviation obtained through the five questions. It can be seen that the item for question number "*I would be able to use online educational tools even if there is no one around to tell me how to use them."* shows the highest average mean of 4.467. However, item 3 "*The delivery of content is organized and in line with the topics presented*." and item 5 "*Content delivery can attract student interest*" recorded a lower mean of respondents 4.300 and 4.133, respectively.

The result of this study shows that one of the factors that influence the student interest in item 1 has a positive relationship with the presentation design and content as in items 3 and 5. It implies that the effectiveness of blended learning in educating the students' interest significantly depends on content delivery and presentation design. Hence, blended learning can attract live instruction learning if the information presented is interesting well-designed organized.

5.0 Discussion and Conclusions

Embedding technologies in the classroom helps in enhancing teaching and facilitating learning. Blended learning for engineering mathematics was investigated based on learning aid requirements, digital skills efficiency, and the use of e-learning in education. The result shows that the hypothesis proposed has a significant relationship between teaching methods and the effectiveness of blended learning. This is supported by a positive relationship between the presentation design and content delivery that influences the effectiveness of blended learning as a teaching method. In addition, the integration of e-learning in TVET education has a strong relation with student interest in the subjects which improves motivation, performance, and learning engagement. Variations in different learning styles have caused them to explore various learning methods and improve communication between lecturers and students.

In conclusion, the result from this study is declared valid and suitable that with the support of educational institutions, the adoption of CIDOS blended learning system based on the LMS model has enhanced the abilities of students to foster the development of digital technology skills. Therefore, the data collected using survey methods in this study is then to be applied in blended learning engineering mathematics using the CIDOS system with several modifications in presentation design and content delivery. Broadly, the potential of CIDOS is widening access to education needs not only for students but educators as well.

REFERENCES

Abdul Razak, A. N., Noordin, M. K., & Abdul Khanan, M. F. (2022). Digital Learning in Technical and Vocational Education and Training (TVET) In Public University, Malaysia. Journal of Technical Education and Training, 14(3). https://doi.org/10.30880/jtet.2022.14.03.005

Alnajdi, S. M. (2018). The Effectiveness of Designing and Using a Practical Interactive Lesson Based on ADDIE Model to Enhance Students' Learning Performances in University of Tabuk. Journal of Education and Learning, 7(6), 212-221.

Amin, F. M., & Sundari, H. (2020). Efl students' preferences on digital platforms during emergency remote teaching: Video conference, LMS, or messenger application? Studies in English Language and Education, 7(2), 362-378. https://doi.org/10.24815/siele.v7i2.16929

Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., & Zawacki-Richter, O. (2018). Digital transformation in German higher education: student and teacher perceptions and usage of digital media. International Journal of Educational Technology in Higher Education, 15(1), 1-20.

Dzakiria, H., Don @ A Wahab, M., & Dato' Abdul Rahman, H. (2012). Action research on blended learning transformative potential in higher education-learner's perspectives. Malaysia: Sciedu Press.

Edwin Obwoge, M., & Stela Kwamboka, O. (2016). E-Learning in TVET: An Opportunity for Developing Countries. IRA International Journal of Education and Multidisciplinary Studies (ISSN 2455–2526), 3(3). https://doi.org/10.21013/jems.v3.n3.p8

F. Hishamudin. (2016). Model ADDIE. Univ. Teknol. Malaysia, no. 1997, p. 1997.

Firman, F. (2020). Impak Covid-19 terhadap Pembelajaran di Perguruan Tinggi. BIOMA: Jurnal Biologi dan Pembelajarannya, 2(1), 14-20.

Gure, G. S. (2019). Primary School Teachers' Competencies for Designing the Instructional Strategies in Teaching on Addie Model. Think India Journal, 22(14), 13820-13828.

Haron, H., Abbas, W. F., & Rahman, N. A. (2012). The adoption of blended learning among Malaysian academicians. Procedia - Social and Behavioral Sciences, 67, 175–181.

Hodges, C., Moore, S., Lockee, B., Trust, T., & Bond, A. (2020). The difference between emergency remote teaching and online learning. *Educause review*, 27(1), 1-9.

Hussin, A. A. (2018). Education 4.0 made simple: Ideas for teaching. International Journal of Education and Literacy Studies, 6(3), 92-98.

Islam Sarker, M. N., Wu, M., Cao, Q., Alam, G. M. M., & Li, D. (2019). Leveraging Digital Technology for Better Learning and Education: A Systematic Literature Review [Review]. *International Journal of Information and Education Technology*, *9*(7), 453-461. https://doi.org/10.18178/ijiet.2019.9.7.1246

Jabatan Pendidikan Politeknik dan Kolej Komuniti, (2023). Hala Tuju Transformasi Politeknik 2023-2030 (ISBN 978-967-0763-65-1), (1).

Kementerian Pendidikan Tinggi Jabatan Pendidikan Politeknik dan Kolej Komuniti, (2023). CIDOS LMS (Moodle v3.11) – User Manual for Lecturer. Januari 2023.
MoHE, M. of H. E. (2015). Executive summary Malaysia education blueprint 2015-2025 (Higher education). https://jpt.mohe.gov.my/portal/index.php/en/corporate/policy-documents/16-malaysia-education-development-plan-2015-2025.

Nasohah, Ummu Nasibah, Muhammad Izuan Bin Abd Gani, Nazipah Binti Mat Shaid, and Md Shaid. (2015). Model ADDIE dalam proses reka bentuk modul pengajaran: bahasa Arab tujuan khas di Universiti Sains Islam Malaysia sebagai contoh. In Proceeding of the International Semeanar on Language Teaching IseLT, pp. 4-5.

Noor, S. F. M., Mohamed, H., Zaini, N. A., & Daiman, D. (2022). Use of Interactive Multimedia e-Learning in TVET Education. International Journal of Advanced Computer Science and Applications (ISSN.2156-5570), 13(9). https://doi.org/10.14569/ijacsa.2022.0130929

Ødegaard et al., 2021 Ødegaard, N. B., Myrhaug, H. T., Dahl-Michelsen, T., & Røe, Y. (2021). Digital learning designs in physiotherapy education: a systematic review and meta-analysis [Article]. *BMC Medical Education, 21*(1), Article 48. https://doi.org/10.1186/s12909-020-02483-w

Perrin, D. G., Perrin, E., Brent, M., & Betz, M. (2015). The role of e-learning, advantages and disadvantages of its adoption in higher education. International Journal of Instructional Technology and Distance Learning (ISSN 1550-6908), 12(1).

S. Rajasekar et al., "Research Methodology," J. Math. Behav., vol. 68, no. s1, p. 23, 2006. https://doi.org/10.1093/intqhc/mzg031

Wang, M., & Kang, M. (2006). Cybergogy for engaged learning: A framework for creating learner engagement through information and communication technology. In *Engaged learning with emerging technologies* (pp. 225-253). Springer.

Wu, E., & Patel, S. (2016). Teaching mixed methods research through blended learning: implications from a case in Hong Kong. *Journal of Educational Enquiry*, *15*(1), 15-25.

Yu (2020), Yu, E. (2020). Student-Inspired Optimal Design of Online Learning for Generation Z. *Journal of educators online, 17*(1),n1.

Zulkifli, H., Razak, K. A., & Mahmood, M. R. (2018). The Usage of ADDIE Model in the Development of a Philosophical Inquiry Approach in Moral Education Module for Secondary School Students. Creative Education, 9(14), 2111-2124.