Effective Use of KNX Trainer Kit In Enhancing Students' Understanding Of Building Automation System Course (SEE30093) At Kolej Komuniti Santubong

Azreen Jafaar[1*], Adi Amin Sarkawi Sarie[2] and Saidi Khairul Alimi Othmman[3]

Kolej Komuniti Santubong,
93050 Kuching, Sarawak, Malaysia.

*Corresponding Author's Email: azreenjafaar@kksantubong.edu.my

Article History: Received 15 August 2023; Revised 3 September 2023; Accepted 15 November 2023

Abstract

Practical learning is an effective method of acquiring new knowledge and skills. The purpose of this study is to examine the effectiveness of the use of KNX Trainer Kit teaching aids in assisting students of Semester 3 Certificate of Electrical Technology for Session II 2022/2023 in improving their level of understanding in the Building Automation System course (SEE30093). The three objectives of this study are to examine the effectiveness of the use of KNX Trainer Kit teaching aids in improving students' understanding, identify students' perception of the use of deafness KNX Trainer Kit in helping to improve students' understanding and identify students' level of interest in SEE30093 courses with the use of KNX Trainer Kit. The respondents were 14 students from the Certificate in Electrical Technology program at Kolej Komuniti Santubong. The data obtained was analysed using SPSS version 25 software. Independent sample t-test analysis of the test results between the control group and the treatment group showed that the use of KNX Trainer Kit teaching aids found a significant difference between the test scores of the treatment group, improving students' understanding of the SEE30093 course. In addition, this study also showed that students' perception of the use of the KNX Trainer Kit in helping to improve students' understanding of SEE30093 courses is at a high level. Students' interest in the course increased as lecturers adopted diverse approaches to teaching and learning. However, the KNX eCampus e-learning tools can also be studied to support the course's teaching and learning.

Keywords: KNX Trainer Kit; Building Automation System; Electrical Technology

1.0 Introduction

The Building Automation System course (SEE 30093) at Community College provides essential knowledge on building automation systems, which refers to creating centralized hardware and software networking systems that monitor and control building facilities systems. This course is practically implemented for installing and programming Building Automation System Control applications to cater to the latest technological needs in the industry. The course is three credit hours and contains four main topics: Introduction, Design, Programming, and Project Implementation. The Curriculum Division, Department of Polytechnic and Community College Education (JPPKK) introduced the course for the Certificate in Electrical Technology (SKE)

program under curriculum version I in Session I 2021/2022. The first batch of students to study the course was in Session I 2022/2023, now in their third semester (SKE 3). It was found that there are some constraints of learning and teaching (T&L) facilities and tools faced by lecturers and students to achieve the learning objectives set.

Some approaches lecturers take include introducing facilities such as the KNX Trainer Kit and KNX ETS eCampus in teaching and learning. The KNX Trainer kit is a compact panel for carrying out certain practices, and the KNX ETS eCampus is also an e-learning tool as it is an essential training tool for building automation with KNX. The KNX Trainer kit produced is a compact panel to perform practical installation of the BUS System using the KNX system. The KNX Trainer kit facilitates wiring by connecting each terminal using wire cable banana plugs with male and female Connectors in plug-and-play. Each fundamental component of the BUS system wiring has been arranged and labelled on the dashboard of The KNX Trainer kit following the requirements of the KNX System circuit. The KNX Trainer kit is developed at an affordable, safe-to-use, and user-friendly cost.

2.0 Problem Statement

Konnex (KNX) is a global standard used in the building automation industry to operate and integrate various electronic systems and devices in a building. In line with Malaysia's goal towards adopting the Industrial Revolution 4.0 (IR4.0), higher learning institutions play a role in educating students to cultivate IR4.0, including understanding and being able to operate automation technology, analyze big data, simulation, cloud, and the Internet of Thing (IoT) in their daily lives. Kolej Komuniti Santubong is a Community College that offers a Certificate in Electrical Technology (SKE) program in line with the latest trends and the country's economic growth. All SKE 3 students studying at Kolej Komuniti Santubong are required to register for the SEE30093 course. This course is one of the most challenging for students to comprehend as it involves the input and output of ETS software. This research is supported by the Session I 2022/2023 test results. The survey found that students failed to solve configuration problems using the medium. Preliminary surveys also found that students lacked understanding and confidence in the topics in the SEE30093 course without the guidance of lecturers, thus contributing to a decrease in students' interest and motivation to study outside of lecture hours. Therefore, the researchers carried out an improvement action to enhance the student's understanding of topics such as Topic 1.0, Introduction to Building Automation Systems, Topic 2.0, Building Automation System Design, and Topic 3.0, Building Automation System Programming.

The results of Test 1 for Session I 2022/2023 can be seen in Table 1.

Table 1: Session I 2022/2023 test results

Grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	F
No. Of Students	0	0	0	0	0	0	3	11	0	0	0	0

Based on the analysis of the theoretical test results for the SEE30093 course, the students were less encouraged by achieving C+ and C grades alone, indicating the student's understanding at a moderate level. Therefore, the determination to improve the grade percentage in the future has given the course lecturers the space and opportunity to produce KNX Trainer Kit teaching aids and further study the effectiveness of the use of KNX Trainer Kit teaching aids in improving students' understanding of SEE30093 courses.

3.0 Objectives of the study

The objectives of this study are:

iv. Study the effectiveness of KNX Trainer Kit teaching aids in improving students' understanding of SEE30093 courses.

v. Identify students' perceptions of using the KNX Trainer Kit interactive device to help improve understanding.

vi. Identify students' level of interest in SEE30093 courses with the use of the KNX Trainer Kit.

The following are the questions of this study:

i. Is there a significant difference in achievement between students exposed to KNX Trainer Kit (control group) teaching aids and students taught using conventional methods (treatment groups)?

ii. What is the student's perception of using the KNX Trainer Kit interactive device to help improve student understanding of the SEE30093 course?

iii. How high is the level of interest students have in SEE30093 courses when using the KNX Trainer Kit?

4.0 Literature Review

Although the conventional T&L method is dominant in the education system, game-based learning methods are increasingly becoming an option among educational instructors. According to Fuada (2022), the trainer kit also supports the efficient implementation of practicum without compromising the learning objectives due to the ease of operation (plug and play through jumper cables) compared to fully assembling the circuit using a project board. Learning media are needed to stimulate students' thoughts, interests, and feelings to achieve the objectives of learning to practice electric power generation. Students can learn about electrical power generation using a Trainer Kit for a Hybrid On-Grid Solar Power Generation System practically and engagingly (Ali et al., 2021). There is an increase in the quality of learning on critical thinking skills, motivation, and competence of Electrical Engineering students by implementing a trainer kit in project-based learning (Haryudo et al., 2021). Therefore, it is recommended that instructors adopt

this game-based learning method to improve the quality of learning and teaching in the Electrical Technology program specifically.

Gamification is a promising approach to enhance learning and teaching by incorporating game elements and mechanics into educational contexts. According to Hermizul et al. (2022), gamification can create an exciting and entertaining learning environment that motivates and engages learners in-class participation. Some shared gamification features include points, badges, levels, challenges, and feedback, which can transform conventional educational scenarios into more interactive and immersive experiences (Zuhriyah & Pratolo, 2020). Gamification can also be applied to practical learning, such as using a conveyor trainer kit and module of PLC, which can improve student learning outcomes in cognitive, psychomotor, and affective aspects (Sukir et al., 2018). Therefore, gamification is a potential strategy to foster students' learning and achievement in various domains and settings.

5.0 Methodology

Researchers used the independent sample t-test to analyze test results for two different study sessions to answer study question 1. Samples for Session I 2022/2023 do not use the KNX Trainer Kit device. The 2022/2023 session II sample is also a treatment sample using the KNX Trainer Kit device in the SEE30093 course teaching and learning session. Survey study design is a procedure in quantitative research in which researchers survey a sample or the entire (Creswell, 2005). Therefore, the question of studies 2 and 3 is to use quantitative approach survey methods. In this study, the instrument used was the form of a questionnaire adapted from the Hermizul, Nasrul, and Asnidatul (2022) study. However, we made improvements and adjusted them according to the study title.

5.1 Study samples and instruments

This quantitative study was conducted at Kolej Komuniti Santubong, considering the population of students in Semester 3 Session I 2022/2023 who took the SEE30093 course. Based on Krejcie and Morgan (1970), for a population of 14 people, it is recommended that all respondents be taken as a sample of the study. Since 14 students of Kolej Komuniti Santubong attended the SEE30093 course for Session II 2022/2023, their whole was taken as a sample of the study. The sampling method used is a stratified method in which respondents are selected based on students taking the SEE30093 course. The data were analysed through the test results for the SEE30093 course in Session II 2022/2023, which included the treatment group of students using the KNX Trainer Kit teaching aid and the comparison was done with the control group students who followed the T&L conventionally students who took the SEE30093 course in Session I 2022/2023.

6.0 Results And Discussions

6.1 Review Question 1

"Is there a significant difference in achievement between students exposed to KNX Trainer Kit teaching aids and students taught using conventional methods?"

Table 2(a): Basic Statistical Results Table

	Mean	N	Standard Deviation
Control group	53.43	14	2.652
Treatment group	67.00	14	9.34

From Table 2(a), the basic statistics show that the mean and standard deviation of student achievement on the control group test are 53.43 and 2.652. At the same time, the mean and standard deviation of student achievement in the treatment group were 67.00 and 9.34. The mean difference between the postal test and the pre-test is -13.571 (Refer to Table 2 (b)). Based on Table 2(b), the statistics of the test t are significant ($t = -5.230$; $DF = 26$; $p < 0.000$) with a negative value t indicates that there is sufficient evidence rejecting the null hypothesis that states there is no significant difference between the two groups. This result means that innovative treatments or programs carried out by researchers have resulted in better student achievement. In other words, the innovations carried out by lecturers significantly managed to produce better achievements.

The T&L method using the KNX Trainer Kit device seeks to create a more fun and effective learning atmosphere while increasing students' focus on activities in the classroom. This result can also improve student achievement in the SEE30093 course. The test results for the assessment in that semester can prove the impact of using the KNX Trainer Kit device. The results show increased exam grades after using the KNX Trainer Kit. Therefore, using the KNX Trainer Kit device has produced results as expected.

These findings are consistent and in line with the findings reported by Tangkui & Tan (2020) and Jamaluddin et al. (2016), which prove that the learning method by adapting the game method improves students' academic achievement in the courses learned. This result is because the game method has opened opportunities for students to learn more creatively, stimulate more critical and creative thinking, and even have fun and increase their focus on learning. As a result of the above data findings, it can also be concluded that there is a significant difference in achievement between the students of the 2022/2023 Session II semester exposed to the KNX Trainer Kit teaching aid and the previous semester students, i.e., the semester I 2022/2023. which is taught using conventional methods. This result is because the percentage of grade achievement for the test has increased.

2(b): Independent sample t-test analysis results

	Levene's test		t	df	Sig.	Difference Mean
	F	Sig.				
Mark (equal variances assumed)	15.144	0.001	-5.230	26	0.000	-13.571

6.2 Review Question 2

"What is the student's perception of using the KNX Trainer Kit interactive device to help improve student understanding of the SEE30093 course?". A scale of 1 to 5 was given to respondents to express students' Perception of the Use of KNX Trainer Kit Interactive Devices in Helping to Improve Students' Understanding of SEE30093 Courses. According to Ahmad Mustafa & Sariff (2017), the perception scale with five points marks on the Likert scale needs to be changed to three points to facilitate the data analysis, such as in Table 3.

Table 3: Student Perception Scale

Acceptance scale	Mean
High	4.00 - 5.00
Moderate	2.01-3.99
Low	0 - 2.00

Sources: Ahmad Mustafa & Sariff (2017)

From the studies done, the results obtained on students' perception of using the KNX Trainer Kit are as follows:

Table 4: Student's Perception of the Use of KNX Trainer Kit in Helping to Improve Student Understanding for SEE30093 Course

Item No.	Item statement	Mean	Standard deviation
S1	I enjoy it when lecturers use the KNX Trainer Kit during the teaching and learning process.	4.57	0.514
S2	The use of the KNX Trainer Kit is very interesting and not boring.	4.43	0.514
S3	I am very excited to use this KNX Trainer Kit.	4.36	0.497
S4	The KNX Trainer Kit display is very interesting, creative, and interactive.	4.43	0.514
S5	The KNX Trainer Kit is an effective teaching aid in the classroom.	4.14	0.663
S6	This KNX Trainer Kit makes me recall the topics taught	4.36	0.633
	Overall average	4.38	0.556

Table 4 shows the average Item S1, "I enjoy it when lecturers use KNX Trainer Kit during the teaching and learning process." recorded the highest mean of 4.57. In contrast, the second highest item (4.43) was "The use of KNX Trainer Kit is very interesting and not boring" and "The KNX Trainer Kit display is very interesting, creative and interactive." This result is because the KNX Trainer Kit delivery method consists of an interface that uses interesting graphics, and students can actively interact while using this innovation. The findings of this study are supported by Mohd Nawi (2020), who said the multimedia media elements found in teaching and learning, such as the use of colour, music, animation, and images, can make learning more real, whether in training, practice, or simulation. Muhamad Asrul, Farah, and Nurhan (2022) also found that users are more interested when the display is interesting and interactive in the application used because it can provide satisfaction and motivation to users. This result is because multimedia elements can make difficult teaching more understandable.

In conclusion, from the analysis of questionnaire data on students' perception of the use of KNX Trainer Kit in helping to improve students' understanding of the SEE30093 course, it was found to be at a high level of KNX Trainer Kit in learning sessions.

6.3 Review Question 3

"To what extent is the student's level of interest in the SEE30093 course when using the KNX Trainer Kit?"

Table 5: Student's Interest Level in Course SEE30093 After Using the KNX Trainer Kit

Item No.	Item statement	Mean	Standard deviation
S1	I can understand the SEE30093 course more clearly.	4.07	0.616
S2	I am more excited to learn the SEE30093 course.	4.36	0.745
S3	I like to explore every problem in the SEE30093 course.	4.21	0.699
S4	I like to do training for SEE30093 courses because it can improve my skills.	4.29	0.611
S5	For me, the SEE30093 course is very easy to understand the concept.	4.43	0.756
S6	I think it is nice to be able to answer the SEE30093 course questions correctly.	4.21	0.699
S7	I do not like to skip classes for SEE30093 courses.	4.57	0.646
S8	I made enough preparation for the exams and quizzes for the SEE30093 course.	4.36	0.633
S9	I always ask lecturers when I do not understand SEE30093 courses.	4.21	0.699

S10	I am determined to get excellent results for the SEE30093 course.	4.50	0.519
	Overall average	4.32	0.662

Table 5 shows that the total mean and standard deviation averages are 4.32 and 0.662, respectively. The item with the highest mean value was "I do not like to skip classes for SEE30093 courses". Meanwhile, "I am determined to get excellent results for the SEE30093 course" recorded the second-highest mean value of 4.50. This study's findings align with several past studies, such as the studies conducted by Jaafar and Mat Said (2019), which emphasized that the use of innovation in teaching and learning can have a huge impact on the process of teaching and learning in the classroom. In addition, the use of multimedia can not only create a sense of interest and fun to learn and produce students who are good at thinking, creative, and critical (Tangkui & Tan, 2020).

The conclusion of the above data analysis shows that when lecturers use a diverse approach to teaching and learning, it will affect the student's interest in the course. In addition, it will provide meaningful teaching and learning experiences to the students and even increase their motivation to learn.

7.0 Conclusion

The study has demonstrated the positive impacts of using KNX Trainer Kit teaching aids on students' achievement in the SEE30093 course at Kolej Komuniti Santubong. However, some limitations and suggestions can be considered for future research.

First, the study's small sample size was only 14 students. A larger sample size would increase the generalizability and validity of the findings. Future research could involve more students from different community colleges or courses using KNX Trainer Kit teaching aids.

Second, the study only measured the immediate effect of using KNX Trainer Kit teaching aids on students' achievements by comparing the pre-test and post-test scores. A long-term effect of using KNX Trainer Kit teaching aids on students' retention and application of knowledge could be explored for future research by conducting more follow-up tests or surveys after a certain period.

Third, the study did not examine the factors that might influence the effectiveness of using KNX Trainer Kit teaching aids, such as students' motivation, interest, prior knowledge, learning styles, and instructor feedback. Future research could investigate how these factors affect student learning outcomes and satisfaction when using KNX Trainer Kit teaching aids. Future research could also compare the effectiveness of using KNX Trainer Kit teaching aids with other digital learning tools or methods.

Acknowledgements
The authors would like to thank all the people for supporting the publishing of this research.

Author Contributions
Jafaar, A.: Conceptualisation, Methodology, Software, Writing- Original Draft Preparation;
Sarkawi Sarie, A. A.: Data Curation, Validation, Supervision;
Othmman, S.K.A.: Software, Validation, Writing-Reviewing and Editing.

Conflicts Of Interest
The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its submission, and declare no conflict of interest in the manuscript.

References
Abdul Rashid M. H. & Narowi M. (2021). Keberkesanan Pengajaran Dan Pembelajaran Terhadap Mata Pelajaran Pendidikan Islam Secara Dalam Talian: Perspektif Guru Di Sekolah Maahad Hafiz, Klang. *Journal of Ma'alim al-Quran wa al-Sunnah* Vol. 17, Special Issue, (2021), pp. 114-128. elSSN: 2637-0328.

Ahmad Mustafa N. H. & Sariff S. A. (2017). Persepsi Pelajar Mengenai Penerapan Kaedah Permainan Dalam Proses Pengajaran Dan Pembelajaran Bagi Pelajar Sijil Pengoperasian Perniagaan Kolej Komuniti Selandar, Melaka. *Prosiding Seminar Pembelajaran Sepanjang Hayat Kolej Komuniti Melaka & Negeri Sembilan* (Jilid 1). https://doi.org/1079294

Ali, M., Wardhana, A. S. J., Damarwan, E. S., Muhfizaturrahmah, Yuniarti, & Bagas, W. S. (2021). Design and Implementation of Trainer Kit for Hybrid On-Grid Solar Power Generation System. *Journal of Physics: Conference Series*, 1737(1), 0–8. https://doi.org/10.1088/1742-6596/1737/1/012002

Cordova, D. I., & Lepper, M. R. (1996). Intrinsic motivation and the process of learning: beneficial effects of contextualization, personalization, and choice. *Journal of Educational Psychology*, 88, 715-730.

Creswell, J. W. (2005). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. Upper Saddle River, NJ: Pearson.

Emaliana I., (2017) Teacher-centered or Student-Centered Learning Approach to Promote Learning?

Fuada, S. (2022). Development of Educational Kit for Practical Course in the Topic of Phase-Shift RC Oscillator. *International Journal of Online and Biomedical Engineering*, 18(5), 112–130. https://doi.org/10.3991/ijoe.v18i05.29131

Jurnal Sosial Humaniora (2017), Volume 10, Ed 2. ISSN Online: 2443-3527ISSN Print: 1979- 5521.

Hanan, A. et al (2017). Journal of Physics: Conference Series, Volume 892, The 6th International Conference on Computer Science and Computational Mathematics (ICCSCM 2017) 4-5 Mei 2017, Langkawi, Malaysia.

Harun, J. & Tasir, Z. (2003). Multimedia Dalam Pendidikan.Kuala Lumpur. PTS Publication & Distributor Sdn. Bhd.

Haryudo, S. I., Ekohariadi, E., Munoto, M., Rijanto, T., & Baskoro, F. (2021). Implementation of Trainer Kits in Project-Based Learning to Improve Critical Thinking, Motivation, and Competency of Electrical Engineering Students. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 6(12), 1947. https://doi.org/10.17977/jptpp.v6i12.15179

Hassan, R., & Poopak, M. (2012). The effect of card games and computer games on learning chemistry concepts. Procedia - Social and Behavioral Sciences, 31, 597601.

Hermizul, N., Nasrul, A.M & Asnidatul, A. I. (2022). Keberkesanan penggunaan IoT trainer smart kit dalam meningkatkan pemahaman pelajar terhadap kursus embedded IoT (DFN 40242) di Politeknik Balik Pulau. 2nd International Multidisciplinary Academic Conference (IMAC'2022) embracing technology in teaching and learning in new norm education. Kota Kinabalu, Malaysia. https://www.researchgate.net/publication/364773008

Ibrahim J. (2006). Gaya pengajaran guru bahasa Daerah Hulu Langat: Satu kajian Tinjauan. Kertas Projek Sarjana Pendidikan, Fakulti Pendidikan, Universiti Kebangsaan Malaysia, Bangi. Jurnal Pendidikan Malaysia, 34(1) (2009): 67-92.

Ishak, H., Mat Nor, & Z. Ahmad, A. (2017). Kajian Pembelajaran Interaktif Berasaskan Peranti Kahoot dalam Pengajaran Abad ke -21, Jabatan Pendidikan Khas, Institut Pendidikan Guru Kampus Darulaman Jitra, Kedah. Prosiding Seminar Pendidikan Serantau ke-VII, Fakulti Pendidikan, Universiti Kebangsaan Malaysia & Fakultas Keguruan & Ilmu Pendidikan Universitas Riau, 7 September 2017.

Jaafar H. H. & Mat Said M. H. (2019). lnovasi Pengajaran Untuk Menarik Minat Pelajar Menguasai Ilmu Tajwi. *International Journal of Humanities Technology and Civilization (IJHTC), Universiti Malaysia Pahang Press*, ISSN: 2289-7216. e-ISSN: 2600-8815 (ONLINE) IJHTC Issue 6, Vol 1 Disem ber 2019. pp 8-17.

Jaijairam, P. (2012). Engaging accounting students: how to teach principles of accounting in creative and exciting ways. *American Journal of Business Education*, 5(1), 75-78.

Jamaluddin, J. et. al., (2016). Keberkesanan Kaedah Permainan dalam Pengajaran dan Pembelajaran Prinsip Perakaunan di Sekolah Menengah. Konferensi Akademik KONAKA 2016: UiTM Pahang Volume: 2016.

Klemes, J. J., Kravanja, Z., Varbanov, P. S., & Lam, H. L. (2013). Advanced multimedia engineering education in energy, process integration, and optimisation. *Applied Energy*, 101, 33-40. doi 10.1016/j.apenergy.2012.01.039.

Krejcie, R.V., & Morgan, D.W., (1970). Determining Sample Size for Research Activities.Educational and Psychological Measurement.

Mayer, R. E. (2014). Incorporating motivation into multimedia learning. Learning and Instruction, 29, 171-173. doi 10.1016/j.learninstruc.2013.04.003.

Muhamad Asrul, A.M.N., Farah, W.O. & Nurhan, A. (2022). Usability And Acceptance Of Augmented Reality (AR) Applications For SKR 3302 Vehicle Air Conditioning System Maintenance Course At Kolej Komuniti Pasir Salak, *Politeknik & Kolej Komuniti Journal of Life Long Learning*, Vol. 6, page 31-40, https://app.mypolycc.edu.my/journal/index.php/PKKJLLL/article/view/108/67

Saleh, S. M., & Sulaiman, H. (2019). Gamification in T&L of mathematics: Teacher's willingness in using Quizizz as an additional assessment tool. AIP Conference Proceedings, 2184. https://doi.org/10.1063/1.5136373.

Shangguan, C., Wang, Z., Gong, S., Guo, Y., & Xu, S. (2020). More Attractive or More Interactive? The Effects of Multi-Leveled Emotional Design on Middle School Students' Multimedia Learning. Front. Psychol. 10:3065. doi: 10.3389/fpsyg.2019.03065.

Sukir, S., Soenarto, S., & Soeharto, S. (2018). Developing conveyor trainer kit for programmable logic controllers in practical learning. *Jurnal Pendidikan Vokasi*, 7(3), 329. https://doi.org/10.21831/jpv.v7i3.15352

Tangkui R. & Tan C. K. (2020). Pembelajaran Berasaskan Permainan Digital Menggunakan Minecraft: Peningkatan Pencapaian Murid Dalam Pecahan. *e-Jurnal Penyelidikan Dan Inovasi*. eISSN 2289-7909. Kolej Universiti Islam Antarabangsa Selangor. Vol.7 Edisi Khas (Disember 2020): Pp 75-90.

Wahid R., (2020). Keberkesanan Pembelajaran Berasaskan Permainan Dalam Kalangan Pelajar Institusi Pengajian Tinggi. *Journal of Education and Social Sciences*, Vol. 16, lsu 1, (Oktober). ISSN 2289-9855.