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Digital Learning Content in Automotive Technology Program Towards Student Cognition in TVET: A Partial Experiment

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ABSTRACT

This study examines, via a partial experiment, the impact of the automotive technology program digital learning content on students' cognition. Consequently, the researcher conducted a partial experiment in this study to evaluate the functionality and usability of digital content. It fits with the social stigma of TVET, shaped by the perception that vocational education and training exist to serve school leavers rather than as an essential strategy to provide competent workers to the labour market. In total, 47 students in the Bachelor of Engineering Technology (Honours) in the Mechatronics (Automotive) programme participated in the investigation. The study's findings indicated that digital learning content has a significant positive influence on the cognitive and psychomotor achievement of students. The functionality of digital learning content is evaluated based on its capacity to produce the desired learning outcomes and its compatibility with the current curriculum. Assessing the usability of digital learning content involves measuring usability, navigation, and overall user experience. This evaluation demonstrates that the digital learning content is functional and usable, providing students with a positive learning experience. In addition, the results of this test demonstrate a significant improvement in students' cognitive achievement, indicating that digital learning content is beneficial in facilitating the learning process, and students are evaluated on their ability to perform practical tasks related to the course material. The results of this evaluation demonstrate a significant improvement in the psychomotor performance of students, indicating that digital learning content can enhance their practical skills. This study concluded that incorporating digital learning content into the curriculum for automotive technology has a significant positive influence on students' cognitive and psychomotor achievement. Available digital learning content can facilitate learning and provide students with a positive educational experience. These findings suggest that incorporating digital learning content into automotive technology programs may be a valuable addition to conventional learning methods. This study implies that digital learning effectively facilitates the learning process and that students are evaluated on their ability to complete practical tasks related to the course material. Consequently, this study was conducted to aid educators in using digital learning for students in automotive programs.

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1. Introduction

Technical and Vocational Education Training (TVET) in Malaysia appears to be the last resort as an academic option for underqualified students [1], with the particularity of limited prospects for further professional and educational development of the graduates in Malaysia. It aligns with the TVET societal stigma shaped by the impression that vocational education and training exist to serve school dropouts instead of viewing it as a crucial strategy in providing skilled workers for the employment market. It should also be noted that the TVET-based qualifications and TVET careers are perceived as lowly and poorly recognized in the workplace; existing education systems have resulted in such disparities between student levels and the demand and requirements of the labour market, ultimately resulting in a substantial economic loss [2]. It is mainly due to the highly fragmented landscape formed by several agencies and ministries issuing different TVET certifications, which results in employers' need recognizing guise those TVET certifications [3].

Digital learning content, in the broadest sense, is the use of game components in non-game contexts to make a product or service more engaging to the user. In a learning context, it is an educational strategy to motivate and engage students to inspire learning and pique their curiosity [4] enumerated some essential features inherent to digital learning systems. First, goals that give the game a purpose and provide the gratification of completion and a sense of accomplishment. Second, the system's rules establish boundaries and limitations, stimulating creativity and presenting obstacles to surmount. Third, a form of progression-indicating feedback. The fourth factor is rewards, including insignia, mementoes, or material benefits such as gifts or money. Lastly, motivation can be intrinsic (desire to learn, develop, and pride) or external (money and grades). A final element frequently neglected is that it should have the freedom or right to fail. In other words, failure to conclude the game should not impact the user's experience or loss. It is demonstrated by [5], who found that participants who accumulated few rewards had a negative attitude towards the digital badge system.

Digital learning in a learning context is criticized for creating intrinsic motivation outside of learning, oversimplifying complex issues, a manipulative framework, and inefficacy for all types of learners. Despite all the criticism, this need translates into one of the world's most dynamic and fastest-growing industries [6]. Literacy availability of digital learning content across the globe has altered the perception of what was once known as "knowledgeable," where the focus of literacy is the ability to read and write linear texts, which is significantly different for young people. The increasing demand for young people to comprehend the various possibilities of concepts and ideas that can be explained or presented through various texts associated with multimodal forms such as visual images, videos, hypertext, and graphic user interface elements that contain written text in the mode of content learning [7].

The automotive industry has advanced technological capabilities. Hybrid, electric, and self-driving intelligent vehicles, as well as Internet of Things (IoT) integration in IoT-connected vehicles, are examples of industry innovations. Therefore, the automotive technology program should conform to modern fractionation trends. The automotive industry faces operational inefficiencies and security problems contributing to cyber-attacks, unjustified deaths, incidents, losses, inflated costs and prices for spare components and services [8]. These concerns now involve diverse and heterogeneous vehicle life cycle stakeholders. According to [9], Industry 4.0 takes advantage of advancements in multiple fields that enable the massive use of sensors, big applications of data techniques, improvements in connectivity and computational power, the emergence of new machine learning approaches, the development of new computing paradigms, or the use of robotics and 3-D or 4-D

printing. Complex heterogeneous connected and autonomous network systems with expanding capabilities enable various features and services.

Nonetheless, they carry the possibility of malicious attacks or other dangers, necessitating implementing cyber security in digital learning. Based on [10], The introduction of Industry 4.0 in Malaysia has substantially altered the education sector. In addition, with the transmission of Covid-19 in 2020, educators can improve and collaborate on their instructional methodologies in preparation for the Fourth Industrial Revolution. Due to the global shutdown of Covid-19, all learning methods must be substituted with virtual learning. Despite the outbreak, students must continue living and attending classes virtually. Educators can conceal numerous learning strategies online to engage their students and persuade them that online learning is just as enjoyable as face-to-face instruction. Moreover, Artificial Intelligence technology is a new revolution in Industry 4.0, and integrating AI technology into virtual and face-to-face classes can significantly increase students' interest in attending classes.

Considering [11] finding that it is increasingly difficult to influence the cognitive domain of 21st-century students, the applied education system should be designed emphasizes the affective domain. The achievement of cognitive and psychomotor domains in the automotive industry will only benefit students with corresponding affective skills. Additionally, if students' affective domain is given special attention, it will positively affect their home and community lives. In addition to cognitive and psychomotor domains, effective learning processes consider other domains. However, it also considers the affective domain as a success-influencing factor. If students have high affective domain abilities followed by high psychomotor domain abilities, they will achieve optimal learning outcomes in the cognitive and psychomotor domains [12].

Blended learning demonstrated encouraging results in a quantitative study of university students, with a substantial positive correlation between learning and student engagement and increased lecturer support [13] reported that students' motivation increased when digital learning content was implemented in the classroom, regardless of students' personality traits or prior gaming experience [14] note that digital learning content allows for greater flexibility in structuring curricula in conjunction with increased student engagement in the classroom, particularly among students with low motivation. An empirical study conducted with Malaysian polytechnic students revealed increased student engagement if usability is guaranteed [15]. These studies examined student engagement and motivation, but none assessed the impact of digital learning content on students' abilities. Employers seek the exact skills they should obtain during these formative years.

2. Methodology

Prioritizing the methodology before and during data acquisition is crucial for the success of a research project [16]. The relevant methodology relates to data acquisition, compilation, and analysis [17]. The choice of methodology is a crucial aspect of the research process to ensure that research can be conducted in an orderly and systematic manner. In this chapter, the description of the selected study methods, including the study design, study population, study sample, study instruments, instrument validity, pilot study, data analysis methods, and study assumptions, will be provided in greater detail.

To carry out this research, the researcher has chosen a research design of quasi-experimental study design. "Pre-test Post-test Non-equivalent Comparison Group Design". Quasi-experimental designs are typically used to evaluate the effectiveness of a program when study respondents cannot be randomly distributed [18]. Therefore, this design is in line with the purpose of the study, which is to see the effectiveness of the use of digital learning content in learning the cognitive and

psychomotor achievement of students for the Automotive Powertrain subject. Researchers used a quantitative approach involving the Treatment Group (TG) and the Control Group (CG). This study used this design to study the effect of the independent variable on the dependent variable. Table 1 shows the variables involved in this study.

Table 1
Study variables

Group	Dependent variable	Independent variables
Treatment	Digital learning content	(i) Cognitive achievement
		(ii) Psychomotor achievement
Control	Conventional learning methods	(i) Cognitive achievement
		(ii) Psychomotor achievement

TG will learn via digital learning in this investigation, whereas CG will only use conventional methods. Several control factors, such as instructor, subject, topic, length of study, and external input, should be the same for both the treatment and control groups when conducting the study [19]. It is due to the numerous hazards to the experiment's validity. To obtain excellent experimental results, minimizing and controlling all such effects is necessary [20].

The pre-and post-tests will be administered to TG and CG during the same week to minimize the threat to the validity of "intergroup interactions" [21]. In the first week of this research, a pre-test will be administered before learning commences. Then, TG will receive an intervention involving digital learning content, while CG will continue to utilize conventional learning methods. The duration of the intervention for TG is eight weeks. After the intervention, TG and CG will be given a post-test to compare their previous scores.

The study design for the pre-and post-tests against the treatment and control groups is presented in Table 2. The performance on the pre-test will be used to determine the distinctions between TG and CG. Researchers used pre-test scores to control preliminary differences so that post-test results were not affected by preliminary differences prior to treatment administration. While TG was treated with X using digital learning content, CG received no treatment.

Table 2
Study design for pre and post-tests against TG and CG

Group	Pre-test	Treatment	Post test
TG	O_1	X	O_2
CG	O_3	-	O_4

O1 = O3 is Pre-test, O2 = O4 is Post-test, X = Digital learning content

2.1 Sampling

To collect data from the study cohort, the researcher has chosen two courses containing a total of 47 students from both TG and CG. Intact classroom groups may be utilized in an experimental design in the absence of random sampling, i.e., if existing classroom groups are utilized. Therefore, a non-random sampling procedure will be employed in this research, with the study sample consisting solely of the extant class population of 47 students across two classes. Table 3 displays the study group's division.

Table 3
Study Group's Division

Group division	Number of students
Treatment Group (TG)	24
Control Group (CG)	23

2.2 *Questionnaire*

Questionnaires are the simplest way to collect dat. In addition, the questionnaire is also suitable for use if the researcher is only interested in the respondent's opinion and not the reasons behind it. In this investigation, a questionnaire served as the instrument. This questionnaire consists of six (6) sections, as shown in Table 4.

Table 4
Division of questions in the questionnaire

Question	Item form	Number of items
Section A	Demographics	3
Section B	Evaluation of Functionality	5
Section C	Evaluation of Content	9
Section D	Evaluation of Interaction	6
Section E	Evaluation of Presentation	6
Section F	Comments and suggestions	1

2.3 *Study Procedure*

Before conducting the actual study, the researcher conducted a pilot study to ensure that all instruments used were accurate and met the study's intended goals. Therefore, in this study, 47 students were tested. After conducting a pilot study, the researcher met with lecturers who teach Automotive Powertrain at University Kuala Lumpur Malaysian Spanish Institute (UniKL MSI) to request permission to conduct research on students who are enrolled in Automotive Powertrain. Once the lecturers consented to allow the research to be conducted in their class, a meeting was convened to provide them with explanations and briefings regarding the study's objectives and implementation procedures. This is intended to expose instructors to the implementation of digital learning content.

On the respondents, questionnaires, tests, and a practical evaluation rubric were administered. This instrument is designed to assess the functionality and usability of digital learning content, as well as student achievement. Students were divided into the Treatment Group (TG) and the Control Group (CG) for the duration of the study. The control group uses conventional learning methods, whereas the treatment group uses digital learning content for the duration specified in table 5. Upon conclusion of the intervention, participants were administered a post-test to determine the differences between TG and CG achievement.

Table 5
Implementation period of the actual study

Week	Steps
Week 1	The lecturer explains the topic to be studied as well as the teaching and learning methods that will be conducted for TG and CG.
Week 2	Pre-tests are conducted on students for TG and CG to see the students' level of knowledge. Students were tested using a set of theory tests and practical tests.
Week 3 - 7	The researcher assists the lecturers in carrying out the teaching and learning process by using digital content for TG and conventional approach for CG.
Week 8	Post-tests were conducted for both groups after the teaching and learning process is completed. Students were tested using a set of theory tests and practical tests. The functionality and usability questionnaire were only given to students from TG.

This research was conducted for a total of eight (8) weeks at the University Kuala Lumpur Malaysian Spanish Institute (UniKL MSI). The study was conducted at UniKL MSI since the Labtech digital learning content is already deployed and utilized at the institution. In the first week, the researcher explains only the topic to be examined and the teaching and learning strategies that will be implemented for TG and CG. During the second week, the researcher conducts only TG and CG pre-tests. In the third week, the researcher implements a five-week treatment method for the TG, while the CG receives conventional teaching and learning strategies. In the concluding week, which is the eighth week, the researcher administers a post-test to both groups of students to assess their performance. To assess the functionality and efficacy of the digital learning content, a questionnaire will be disseminated separately to TG students only.

3. Results

This section provides user feedback and expert analysis of the digital learning content. 75% of the treatment group contributed to evaluating functionality and usability. The evaluation was administered during the final class session and examination. Most respondents required between 5 and 10 minutes to complete the evaluation. No missing value was identified; however, only 40% of respondents provided a suggestion or comment in response to the open-ended query.

3.1 Effectiveness Context

The user evaluation of the functionality and usability of digital learning content is presented in Table 6. Most respondents (89%) concur that digital learning content is effective. The item with the maximum degree of accord is "I would recommend this application to my colleagues" (3.722, or 93%). The difference between the greatest and lowest scores is 8%, with 85% of respondents agreeing with the statements "If this application stops, it is difficult to restart it" and "This application has at times stopped unexpectedly." Based on this conclusion, the efficacy of digital learning content must be enhanced. This finding concludes that the application has received generally positive feedback from users and has a high level of effectiveness of approximately 90%. Users would recommend the application to their co-workers and take pleasure in using it. However, some users found it difficult to determine what to do next with the application, and restarting it was not straightforward. The application was also criticised for being sluggish to respond and for stopping unexpectedly. Users also found that the helped information is not particularly useful, and that the application is initially difficult to learn and takes too long to master its functions. Users rated the application's overall satisfaction level at 89%.

Table 6
Level of agreement on digital learning content effectiveness

No.	Item	Score	Level of effectiveness
1.	I would recommend this application to my colleagues.	3.722	93%
2.	I enjoy the time I spend using this application.	3.667	92%
3.	I sometimes do not know what to do next with this application.	3.556	89%
4.	If this application stops, it is not easy to restart it.	3.389	85%
5.	This application responds too slowly to inputs.	3.500	88%
6.	The instructions and prompts are helpful.	3.667	92%
7.	I find that the help information given by this application is not very useful.	3.611	90%
8.	This application has at some time stopped unexpectedly.	3.389	85%
9.	Learning to operate this application initially is full of problems.	3.611	90%
10.	It takes too long to learn the application functions.	3.556	89%

3.2 Controllability Context

The user evaluation of the functionality and efficacy of digital learning content for controllability context is presented in Table 7. 87 percent of respondents concurred that digital learning content could be controlled. The maximum level of agreement is for the statement "Sometimes I feel quite anxious when using this application" (3.611%). Based on this finding, the controllability of digital learning content must be enhanced. This result indicates that the application has received conflicting user feedback. Some users complained that the application caused them migraines and required too many steps to complete a task. However, most users found the application to be well-structured and logical, user-friendly, and entirely responsive to their requirements. In addition, the application enables the user to control simulation components; however, some users find it challenging to learn new functions, and error messages are inadequate. The average contentment rating of the application among consumers was 89%.

Table 7
Level of agreement on digital learning content controllability

No.	Item	Score	Level of controllability
1.	I think this application has sometimes given me a headache.	3.444	86%
2.	It is obvious that user needs have been fully taken into consideration.	3.333	83%
3.	The organisation of the menus seems quite logical.	3.556	89%
4.	The application allows the user to control simulation parts.	3.500	88%
5.	There are too many steps required to get something to work.	3.556	89%
6.	Sometimes I feel quite tensed when using this application.	3.611	90%
7.	Error messages are not adequate.	3.278	82%
8.	It is difficult to learn new function in the application.	3.556	89%
9.	It is easy to navigate through the application.	3.500	88%
10.	It is impossible to learn everything in this application.	3.556	89%

3.3 Efficiency Context

The user evaluation of the functionality and efficacy of digital learning content for efficiency context is presented in Table 8. The results of this survey indicate that users have conflicting opinions regarding the application. Most users find working with the application to be gratifying, but some have concerns about utilising the correct functions and feel safer using only a handful of familiar ones. Nonetheless, many users find the application mentally stimulating. The application received high marks for presenting system information in a plain and comprehensible manner, and its documentation is informative. The application disrupts the way the users prefer to organise their

work, but they feel in control of the application when using it. Users reported that they prefer to utilise the functions they are most familiar with. According to some users, there is never enough information displayed on the screen when it is required. Overall, 89% of the users were pleased with the application.

Table 8
Level of agreement on digital learning content efficiency

No.	Item	Score	Level of efficiency
1.	I sometimes wonder if I am using the right function.	3.667	92%
2.	Working with this application is satisfying.	3.667	92%
3.	I feel safer if I use only a few familiar functions.	3.444	86%
4.	This application seems to disrupt the way I normally like to arrange my work.	3.722	93%
5.	I feel in command of this application when I am using it.	3.389	85%
6.	The way that system information is presented is clear and understandable	3.500	88%
7.	The application documentation is very informative	3.722	93%
8.	There is never enough information on the screen when it's needed	3.611	90%
9.	I prefer to stick to the functions that I know best.	3.444	86%
10.	Working with this application is mentally stimulating.	3.556	89%

3.4 Helpfulness Context

The user evaluation of the functionality and efficacy of digital learning content for the usefulness context is presented in Table 9. Some users find it annoying and inconsistent, and they do not want to use it daily (items 1 and 2). In addition, they find the application cumbersome when attempting non-standard duties (item 4) and find it difficult to comprehend and act upon the information provided by the application (item 5). Nevertheless, some users report that the application makes it easy to complete duties (item 6) and that its performance is adequate (item 7). In addition, some users find that the application helped them surmount any difficulties they had using it (item 8), whereas others find that there is too much to read before you can use the application (item 9) and that they must frequently refer to the guidelines (item 10). The application appears to have area for development regarding usability and user experience.

Table 9
Level of agreement on digital learning content helpfulness

No.	Item	Score	Level of helpfulness
1.	I would not like to use this application every day.	3.389	85%
2.	Using this application is frustrating.	3.667	92%
3.	I think this application is inconsistent.	3.389	85%
4.	This application is awkward when I want to do something which is not standard.	3.556	89%
5.	I can understand and act on the information provided by this application.	3.389	85%
6.	Tasks can be performed in a straightforward manner using this application	3.667	92%
7.	The speed of this application is fast enough.	3.278	82%
8.	The application has helped me overcome any problems I have had in using it.	3.222	81%
9.	There is too much to read before you can use the application.	3.389	85%
10.	I keep having to go back to look at the guides.	3.056	76%

3.5 Learnability Context

The user evaluation of the functionality and efficacy of digital learning content for learnability context is presented in Table 10 It is the result of a survey measuring the degree of accord regarding

an application's learnability. On a scale from 1 to 5, users were asked to rate their level of agreement with various statements about the application, with higher scores indicating greater levels of agreement. The survey revealed that users have varied opinions regarding the application's learnability. Some users find the application simple to navigate and comprehend (e.g., items 1, 4, 8), whereas others find it challenging and aggravating (e.g., items 2, 3, 5, 6, 9, 10). In addition, some users find the aid content needs to be more consistent (e.g., item 7) and frequently require assistance (item 9). Most of the results are positive, but not all are above average. Users generally have varied opinions regarding the application's learnability.

Table 10
Level of agreement on digital learning content learnability

No.	Item	Score	Level of learnability
1.	The application presents itself in a very attractive way.	3.556	89%
2.	This application is very awkward.	3.500	88%
3.	The application hasn't always done what I was expecting.	3.389	85%
4.	It is relatively easy to move from one part of a task to another.	3.556	89%
5.	This application occasionally behaves in a way which can't be understood.	3.444	86%
6.	Getting data files in and out of the system is not easy.	3.278	82%
7.	Either the amount or quality of the help information varies across the system	3.611	90%
8.	It is easy to see immediately what the options are at each stage.	3.556	89%
9.	I must look for assistance most times when I use this application.	3.611	90%
10.	It is easy to forget how to do things with this application.	3.500	88%

Access to all available online resources is possible through a digital learning platform. The design of the software makes information easily accessible to all consumers. The instructional content may include lessons, multimedia files, archives, and evaluations. Access to all available online resources is possible through a digital learning platform. The design of the software makes information easily accessible to all consumers. Learning aids, courses, multimedia materials, archives, and evaluations can all be utilized. All students can obtain the information at any time and from any location using the Internet and a reading device, be it a laptop, tablet, or smartphone. Effectiveness is crucial for digital learning content for some reasons: Improved pupil achievement: If digital learning content is effective, it can assist students in learning more efficiently and achieving higher grades. It can result in improved grades, higher retention rates, and enhanced academic performance overall. Effective digital learning content can be more engaging and pleasurable for students, resulting in higher student satisfaction with their courses and learning experiences. Digital learning content is accessible from anywhere with an internet connection, making it more accessible to students who cannot attend a traditional classroom-based course.

4. Conclusions

The experimental data of digital learning content can be helpful for engineers, as it offers many resources and opportunities for learning and collaboration that can support their work. Digital learning content can be evaluated using a pre-and post-test followed by [22]. A pre-test is administered to students before their exposure to digital learning content [23], whereas a post-test is administered after the completion of the content. Comparing pre-and post-test results makes it possible to assess the impact of digital learning content on student learning. According to this study, using a pre-and post-test design to evaluate the efficacy of digital learning content has some

advantages [24]. First, adjust for pre-existing differences. Pre-tests can account for any pre-existing distinctions between pupil groups, such as prior knowledge or aptitude levels.

It can ensure that differences in learning outcomes are solely attributable to the digital learning content. By comparing the results of the pre-test and post-test, it is possible to measure the extent to which students' knowledge and skills have improved because of the digital learning content in [25] research. Pre-tests can provide a comparison baseline, enabling researchers to determine the impact of digital learning content on student learning relative to their initial knowledge and abilities. This study is a valuable method for evaluating the efficacy of digital learning content [26]. It allows researchers to account for pre-existing disparities and measure how students have improved due to the content [27]. Individuals can now evaluate every aspect of what ICT can and cannot offer thanks to the discipline of digital learning. Since the turn of the millennium, technology has expanded considerably in all areas of study and daily life. People who must keep up with recent technological advancements are viewed as inquisitive and lagging. The effects and ethics of digital vary across communities and societies. It promotes efficacy and efficiency in some areas but not in those where the tool is applicable. Everyone must possess a smartphone to register for access to buildings and areas during the outbreak. Its purpose is to manage and control disease's disorderly and uncontrolled spread.

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