

Enhancing TVET Learning: Aesthetic and Pedagogical Module Design Approach

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Abstract

Currently, the field of education has evolved rapidly, particularly in teaching and learning methods, which now extend beyond just the concept and curriculum of education. Modules are commonly utilized in technical fields to enhance knowledge and skills in the teaching and learning process, particularly in Heating, Ventilation, and Air Conditioning (HVAC), a fundamental area in Technical and Vocational Education and Training (TVET). Incorporating aesthetics in technical learning modules enhances engagement by integrating visual, sensory, and emotional elements. This approach boosts cognitive involvement, motivation, and knowledge retention, creating a more immersive learning experience. As such, the HVAC learning module does not effectively engage cognitive processes, hindering the deep understanding and retention of crucial concepts among learners. Therefore, the main objective of this study is to design, develop and evaluate the effectiveness of the Refrigerant Handling Learning Module for Air Conditioning Systems. The module's design followed the Sidek and Jamaluddin Model, comprising two phases and 8 steps that must be followed during the learning module's creation process. Additionally, this module has been designed based on the Felder-Silverman learning style as a pedagogical technique. This study employs a quantitative methodology utilizing a questionnaire as the research instrument. Three experienced experts in the Refrigeration and Air Conditioning industry provided feedback on the assessment of the developed learning module. The questionnaire evaluates three main aspects: the suitability of module content, module design and module functionality. The questionnaire analysis will be displayed as a percentage. The study determined that the learning module's development achieved its objectives and was deemed satisfactory. The researcher's learning module intends to improve the efficacy and efficiency of teachers and students in the educational process. Ultimately, it is anticipated that the created learning module will be advantageous and yield favorable outcomes in terms of teaching and learning effectiveness for its users.

1. Introduction

Education has adjusted to cater to the changing needs and preferences of society. The improvements in the education sector seek to ensure that the education offered in Malaysia is in line with and comparable to global standards. The Malaysian government is now enacting a programme to synchronise the standard of education in

Malaysia with global benchmarks, as specified in the Malaysian Education Development Plan (2013-2025) (Bakar, 2023). At the highest level of education, students need to not only develop basic thinking skills, but also achieve advanced thinking skills in order to actively engage in increasingly challenging learning activities in the current era (Haniah, Aman, & Setiawan, 2020). Utilising instructional resources in a creative and pragmatic manner improves students' engagement and motivation in the educational process. This is due to its perceived superiority over previous or outdated approaches that are currently impractical. Jensen et al. (2023) assert that teachers need to possess a conscientious temperament in order to effectively educate the younger generation and excel in their teaching methods. Thus, the teacher plays a pivotal role in demonstrating the effectiveness of learning.

Filgona et al., (2020) states that the development of teaching aids can help teachers vary their teaching methods to maintain students' focus and involvement in a specific subject. Therefore, educators should carefully consider how they utilise their own approach to achieve teaching goals. To cultivate a culture of experiential learning, educators must exhibit resourcefulness when determining the most effective method for Active Blended Learning. The use of teaching aids, such as modules, can successfully facilitate the application of the theoretical and practical teaching and learning process (Hamzah, Hamzah, & Zulkifli, 2022). Moreover, it possesses the ability to nurture skilled pupils who meet the requirements of the modern industry. In addition, students' creativity can be fostered by using modules that incorporate a powerful teaching framework (Logan, Johnson, & Worsham, 2021). Currently, the learning module is extensively employed as a pedagogical tool. It is a non-electronic teaching device that operates using analogue technology. Therefore, independent student-centered learning can be achieved through the use of modules, without the need for an instructor's guidance.

Throughout the teaching and learning process, both educators and learners face numerous challenges. An issue that arises is the suboptimal allocation of educational resources. The unattractive use of instructional materials is one of the elements that discourage students from attending the teaching and learning session (Saharudin et al., 2021). Teachers frequently employ whiteboards and dedicate a substantial portion of time at the front of the lecture room during the teaching and learning process (Liang, da Costa Junior, & Piumarta, 2020). It impedes the growth of students' cognitive abilities, since they become passive and depend primarily on listening to the teacher. Utilising modules is a highly efficient approach to guarantee exceptional performance in the teaching and learning process. Implementing modules will improve the understanding of academic subjects.

According to Osman & Hamzah (2016), some elements are essential for effective teaching. To achieve the goal of the Teaching and learning process, educators must take into account several aspects. This includes the title, teaching materials, teaching methods, and the relevant knowledge and abilities needed to effectively deliver the educational content. According to Ismail & Moskam (2017), learning modules are an effective tool for enhancing the teaching and learning process. By using the module as a reference, students' understanding and acquisition of knowledge would be greatly facilitated. The module's result is contingent upon the diverse levels of proficiency or acquisition demonstrated by each participant. When it comes to abilities and skills, people have different levels of intellect. Students with these attributes will easily complete their academic tasks, while students missing them may face challenges, resulting in diminished self-assurance and a feeling of despair (Ramamurthy, DeWitt, & Alias, 2021).

Stanley (2021) posited that many instructional principles given in the classroom may lack clarity and fail to align with real-world scenarios. This will hinder pupils' comprehension of the outcomes of instruction and education. Consequently, an initial survey was carried out to analyse the learning module for the Refrigerant Handling subject in this study. This study entailed conducting interviews with the individual in charge of the Refrigeration and Air Conditioning Workshop Programme at a Technical and Vocational Education and Training (TVET) institution. The findings of this initial survey indicate that the Refrigerant Handling learning module is not tailored for teachers and students who specialise in Refrigeration and Air Conditioning in TVET institutions. Malaysian Vocational Certificate (SVM) students specialising in Refrigeration and Air Conditioning face a predicament as they struggle to comprehend and implement foreign academic and practical concepts. TVET institutions prioritise practical skills, necessitating the employment of demonstration strategies by professors to impart knowledge and talents to students. Yan & Guo (2023) argue that the application of the demonstrative technique in education has a restricted timeframe, making it challenging to replicate. Hence, the used of Felder-Silverman learning style is highly suitable for the development of the forthcoming learning module (Isal, Santoso & Novandi, 2021).

Incorporating aesthetics in education is a critical yet often overlooked component in the design of technical learning modules. Aesthetics in education refers to the integration of visual, sensory, and emotional elements to create a more engaging and immersive learning environment. By appealing to learners' senses and emotions, aesthetic design can significantly enhance cognitive engagement, motivation, and retention of knowledge (Silvia, Astuti & Dewi, 2023). For HVAC education, aesthetics plays a crucial role in overcoming the monotony often associated with technical content. The Refrigerant Handling Learning Module for Air Conditioning Systems incorporates aesthetically pleasing elements, such as clear visual diagrams, intuitive navigation, and interactive components, which not only enhance user experience but also facilitate a deeper understanding of complex

concepts. The application of aesthetically designed learning materials can foster a more enjoyable and engaging learning process, leading to improved educational outcomes (Egan, 2021).

Implementing dynamic and participatory strategies in the educational process can enhance student involvement, hence promoting the understanding of intricate concepts among students with weaker cognitive abilities (Tathahira, 2020). Therefore, the Refrigerant Handling learning module will be developed as instructional materials to improve the efficiency and involvement of the teaching and learning process. Implementing the teaching aids learning module will improve the academic performance and skill acquisition of SVM Refrigeration and Air Conditioning students who are taking the Refrigerant Handling course. Through the utilisation of learning modules, students can acquire knowledge about refrigerant management at their own preferred speed and convenience. Moreover, individuals possess the capacity to establish their own frames of reference to facilitate the understanding of unknown concepts while teaching and learning (Shaffie et al., 2022).

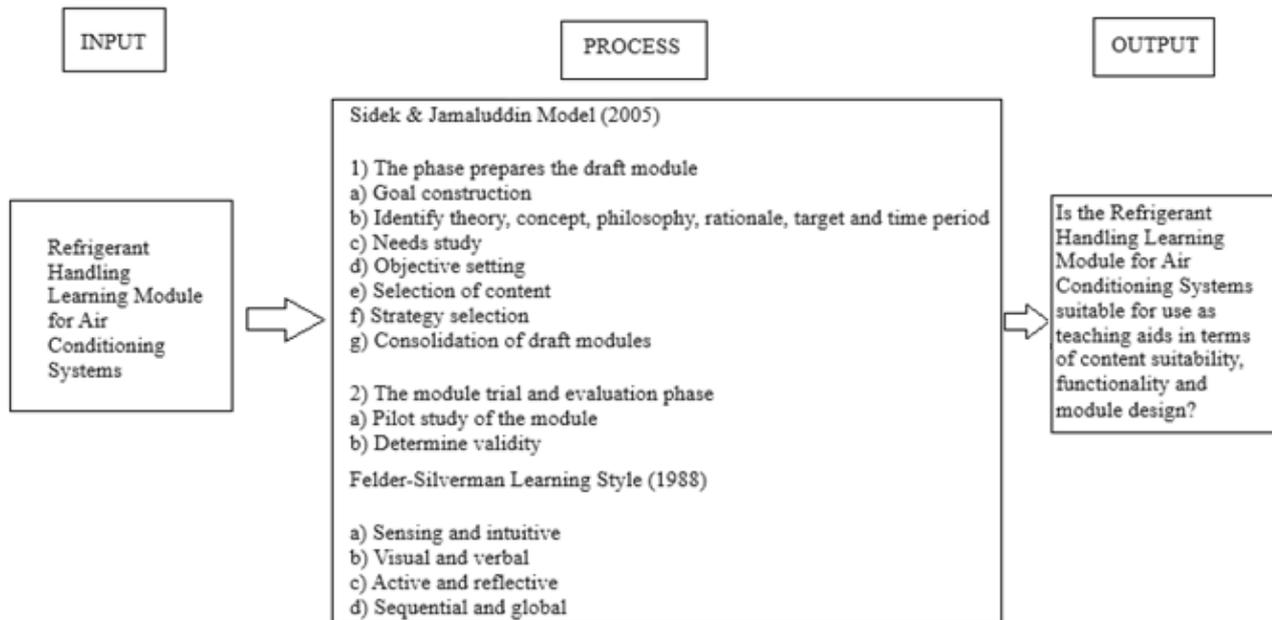


Fig. 1 A conceptual framework for developing learning modules handling refrigerant for air conditioning system

Meyer & Norman (2020) state that individuals possess distinct needs, leading to differences. The requirements involve a range of factors including knowledge, cognitive ability, conduct, and learning preferences. Efficient teaching methods will inspire students to actively engage with and understand the concepts being taught, leading to improved academic performance. Learning style and field education refer to the strategies employed by teachers to convey information to students, involving the acquisition, collection, analysis, and understanding of data in order to develop knowledge (Wolterinck et al., 2019).

Based on the previously mentioned context, the results suggest that the lack of a learning module for the Refrigerant Handling subject poses a difficulty for students pursuing Refrigeration and Air Conditioning in TVET institutions, since they face challenges in accessing appropriate reference resources. Obtaining knowledge without a well-organized educational system will present difficulties for students in fully understanding the subject matter. Mastery of refrigerant handling is crucial for students in this field to effectively employ it in their future professions and meet the requirements of the Heating, Ventilation, and Air Conditioning (HVAC) industry. Moreover, students often face time constraints during the process of teaching and learning. As a result, students will experience a delay in their education, which will have a certain level of influence on their understanding of the subject matter they are studying, particularly in TVET subjects (Mesuwini & Mokoena, 2023).

Consequently, students face difficulties in accurately executing practical activities associated with Refrigerant Handling (Hashim et al., 2022). Various educational methodologies have been devised to improve the calibre and effectiveness of education. Nowadays, educators utilise learning modules as a reference source to facilitate the implementation of the learning process. It will improve the effectiveness of teaching in the classroom. The use of modules as teaching aids can offer information more clearly and methodically to students relevant to the subjects being taught. Therefore, it is crucial to apply this learning module in order to allow students in this field to review and strengthen their comprehension of topics that they struggle with.

Previous researchers have advocated many models of learning styles, including Kolb, Dun and Dun, Felder Silverman, and visual-auditory learning styles. Felder & Silverman (1988) found that people have different learning styles depending on their internal and external capacities to receive, process, and understand knowledge.

Through the analysis of data, facts, and algorithms, students gain and integrate information in many formats. However, there are pupils who demonstrate exceptional understanding when knowledge is delivered in the form of theories or item models. Furthermore, certain children exhibit a heightened ability to understand visual information, such as images and charts, as well as verbal knowledge that can be gained through spoken explanations or lectures. Munna & Kalam (2021) suggest that students might improve their comprehension of subjects by utilising learning tools that integrate visual components. Visual notions aid in the assimilation and solidification of memory, in accordance with cognitive theory.

A learning model is a conceptual framework that delineates the approach or methodology utilised to impart educational knowledge to students. This paradigm includes several methods, tactics, and approaches that seek to improve students' understanding, skill level, and active involvement in the teaching and learning process (Alzaanin, 2023). Students can use the module for self-directed learning. It enables students to learn knowledge not simply inside the limits of the classroom, but also autonomously, without the assistance of an instructor. According to Al Mamun & Lawrie (2023), the learning module should be crafted in a manner that effectively captures the students' attention, motivating them to actively participate in and understand the material. This can be achieved by organising important data systematically, allowing users to achieve their own goals. Therefore, it is crucial to meticulously develop the learning module and strictly stick to the characteristics of a top-notch module in order to correspond with the user's goals.

In 2005, Sidek Mohd Noah introduced the Sidek and Jamaluddin module development paradigm. This model comprises two tiers. The first phase involves creating preliminary modules, while the following phase involves evaluating and assessing the finalised modules. After setting the goals and creating the module draft, the draft preparation stage begins. Moreover, these two phases are essential in the production of an engaging and top-notch module. The researcher has picked Sidek & Jamaluddin's Model (2005) as the ideal framework for the construction of Refrigerant Handling Learning Modules. This is because this approach consists of two unique phases that allow researchers to deliver appropriate and high-quality learning modules for SVM students specialising in Refrigeration and Air Conditioning in TVET institutions. The conceptual framework depicted in figure 1 was established to provide a comprehensive explanation of the learning module development process, encompassing all relevant components.

Moreover, aesthetics supports the alignment with diverse learning styles, such as those defined in the Felder-Silverman learning style model. By integrating visual, auditory, and kinesthetic elements, the module caters to a broader spectrum of learners, making technical content more accessible and engaging. This approach ensures that learners not only comprehend the material but also retain and apply it effectively in real-world scenarios (Marini, 2021). By embedding aesthetics into the Refrigerant Handling Learning Module, this study aims to bridge the gap between technical rigor and learner engagement, ultimately enhancing both the teaching and learning experience in HVAC education within the TVET framework.

2. Methodology

The research design is a crucial component of a study as it serves as a roadmap for the researcher to assure the successful attainment of the study's objectives and the answering of the specified research questions. This study employs a quantitative approach to product development design and is frequently referred to as Design Development Research. The objective of this study is to strategize the creation of an Advanced Blended Learning Module specifically tailored for the topic of Refrigerant Handling in air conditioning systems. The researcher has opted to utilise the Sidek & Jamaluddin (2005) paradigm, which consists of two distinct stages: the draft module preparation stage and the module testing and evaluation stage. This model was selected due to its superior process or methodology for module manufacturing in comparison to other module development approaches.

The population being studied consists of teachers who specialise in Refrigeration and Air Conditioning Technology in TVET institution around Johor, specifically those associated with SVM. The study sample comprises the total population, which consists of three instructors. The study used a purposive sampling method, wherein the researcher deliberately selects a sample to provide a representative sample of the population (Ritchie, Lewis & Elam, 2013). Hence, the participants of this study comprised three instructors specialising in Refrigeration and Air Conditioning Technology in one of the TVET institution in Johor. The researcher has established the precise criteria for picking the respondents who will be chosen as the sample for this study. The qualifications encompass a prerequisite of at least 5 years of professional experience in the field and current employment in the refrigeration and air conditioning business.

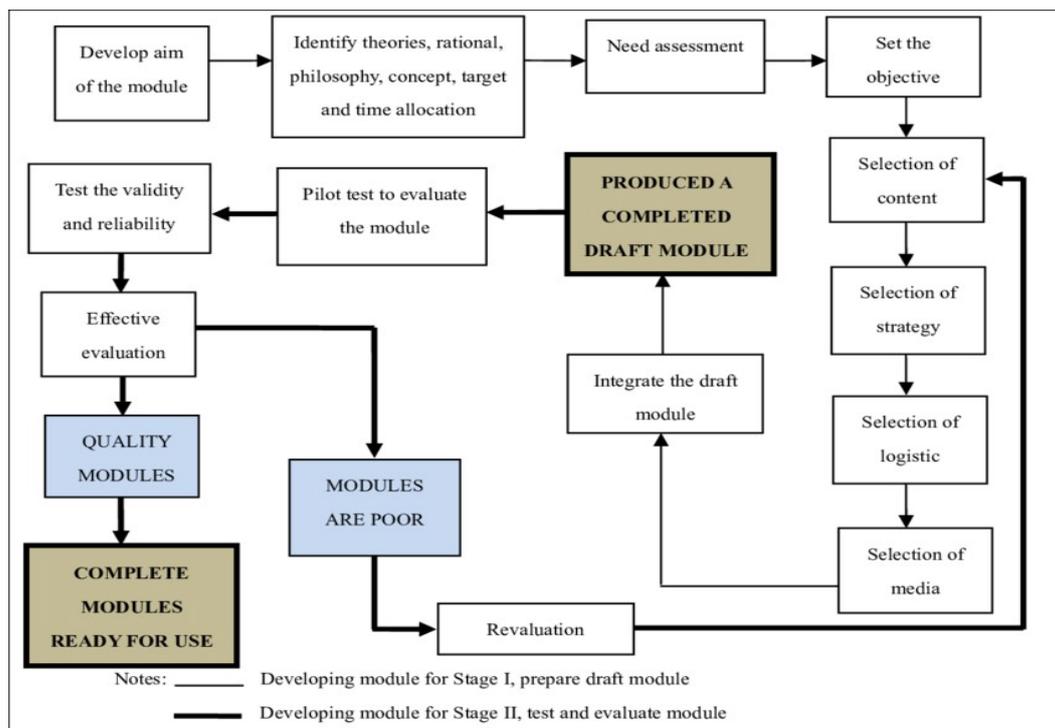
Data for this study was collected and analysed using frequency and percentage values derived from a distributed checklist form. Every item is classified and the frequency data is documented as a percentage to facilitate data analysis. Subsequently, the analysis results will determine whether the produced teaching aids effectively accomplish the intended objective or not. The quantitative data will be analysed by aggregating the collected score values and subsequently calculating a percentage as in table 1, in order to generate research findings that are both legitimate and credible.

Table 1 Formula for total assessment scores

Assessment	Percent %
Height	75-100
Medium	50-74.9
Low	0-49

The researcher chose three experts, specifically lecturers specialising in Refrigeration and Air Conditioning from TVET institution around Johor, to validate the findings. The checklist form consists of 10 module content appropriateness elements in Part B, 5 module functionality items in Part C, and 5 module design items in Part D. Part A of the checklist includes demographic data provided by experts. The amount of agreement is determined by calculating a percentage utilising score values that range from 0% to 100%. This calculation is based on two scale choices, namely "Yes" and "No". The researcher selected this scale due to its facilitation of data collection and its ability to yield a precise evaluation when evaluating the respondents' responses.

In order to produce a module, the researcher must possess a well-defined theoretical framework that guides the design process, ensuring that the various phases are executed meticulously and methodically. Following each of the design processes throughout the construction of a module ensures the creation of a high-quality module with consistent content. Furthermore, it is imperative to adhere to a methodical arrangement within a module to ensure its complete, succinct, and compact production, ultimately leaving a lasting impact on the user. The Sidek & Jamaluddin model development model was utilised to create this learning module. This paradigm is efficacious in facilitating the process of material growth. The production of a module based on the Sidek & Jamaluddin model consists of two phases. The first phase involves generating a draft module, which has nine steps. These processes begin with constructing goals and conclude with consolidating the draft module. Following that, the second step entails the testing and assessment of the draft module. During this phase, the draft module, which has been fully developed, will undergo a pilot study to assess its validity and reliability. Figure 2 illustrates that Sidek and Jamaluddin's model technique consists of two primary phases, which serve as a framework for creating learning modules.

**Fig. 2** Sidek & Jamaluddin model (2005)

i. The phase prepares the draft module.

The process of creating a draft module consists of several steps, starting with the formulation of goals and concluding with the finalisation of the draft module. This phase is sometimes referred to as a preliminary module

that has not yet been validated and deemed dependable by professionals. This step encompasses multiple procedures in the creation of the Refrigerant Handling Learning Module for the Air Conditioning System.

ii. Goal construction.

The researcher needs information regarding the specific demographic of users who will utilise the generated learning module. The intended consumers of the learning modules generated in this project are students enrolled in the Refrigeration and Air Conditioning programme at TVET institution, specifically those studying SVM. Subsequently, the analytical process is conducted to identify the underlying cause or reason that led to the problem. The researcher determined that the development of a learning module is necessary based on the findings of the preliminary survey, which revealed that the Refrigerant Handling subject lacks a module at TVET institution. Subsequently, the researcher establishes the goal of creating the module and assessing its suitability.

iii. Identify the background of the module.

The researcher must ascertain the theories that will be employed in teaching the module, as dictated by the curriculum. The justification for the necessity places emphasis on the topic of Refrigerant Handling for Air Conditioning Systems. The philosophy implemented in this educational module emphasises the fundamental principles that guide both teachers and students during the teaching and learning process. Subsequently, the approach employed involves providing a comprehensive examination of the topic of Refrigerant Handling for Air Conditioning Systems. The duration of the construction of this learning module is determined based on its appropriateness in creating a high-quality module that meets the requirements of both teachers and students. Furthermore, the intended audience comprises SVM students specialising in Refrigeration and Air Conditioning.

iv. Needs study.

Prior to module development, the researcher conducted an initial survey to gather the requisite information. The findings indicate that TVET institution does not offer any additional learning modules pertaining to Refrigerant Handling for Air Conditioning Systems. Hence, the researcher deems it imperative to provide a comprehensive learning module for Refrigerant Handling in Air Conditioning Systems, aligning with the Vocational College Standard Curriculum (KSKV) at TVET institution.

iv. Objective setting.

The construction of module objectives is achieved through the assessment of cognitive domains in accordance with Bloom's Taxonomy. The module objectives based on KSKV include identifying the isolation of cooling system parts for repair, implementing a systematic approach to specific services, and recognising refrigerant recovery alternatives.

vi. Content selection.

The researcher has limited the range of content choices that will be organised based on sub-topics in the upcoming learning module. The forthcoming learning module will only concentrate on the sub-topics outlined in table 2 based on the Refrigerant Handling syllabus.

Table 2 Refrigerant handling module syllabus

Criteria	Explanation
Chapter 1	1.1 Types of system approaches for specific services
Doing Types of	- Isolation
Systems Approach	- Pump down
Introduction	- Recovery
	1.2 Types of cooling circuits
	1.3 Open the system without releasing the refrigerant to the atmosphere
	1.4 Approaches to reduce refrigerant emissions
	1.5 Refrigerant recovery options

vii. Strategy selection.

The researcher has employed a cognitive learning theory approach in the development of the Refrigerant Handling for Air Conditioning Systems learning module. This approach aims to facilitate students' comprehension of the teacher's objectives by incorporating visual aids such as pictures and diagrams in the module.

viii. Consolidate draft modules.

The objective of this step is to generate lesson plans and educational resources. Upon implementation of this stage, a diverse range of media will be utilised for instructional purposes, along with any essential accompanying documentation. Prior to the implementation of this learning module, it underwent rigorous testing to ensure its reliability and usability for users.

ix. The module trial and evaluation phase.

The purpose of this stage is to determine if the learning modules created fulfil the specific criteria that are suitable for SVM students specialising in Refrigeration and Air Conditioning at TVET institution. Furthermore, this study was undertaken to ascertain the suitability of the learning module in terms of explicit instructions, the suitability of the questions provided, and the suitability of the questionnaire format for expert validation.

There are five distinct pedagogical approaches: constructivist, collaborative, reflective, integrative, and inquiry-based. The module's constructivist approach, rooted in the Felder-Silverman learning method, enables learners to develop their own comprehension of the world, drawing from their daily life experiences as they mature. Through specific experiences, individuals convert acquired information into knowledge and comprehension. This learning style provides a comprehensive description of the learning style. This learning style model has undergone modifications that can be categorised into four distinct dimensions: sensing and intuitive, visual and verbal, active and reflective, and sequential and global.

Table 3 Module design based on Felder-Silverman learning style

No	Design	Display and Description
1.	Sensing and intuitive	 <p>1.1 Pengenalan</p> <p>Terdapat tiga jenis silinder Bahan Pendingin (Refrigerant), yaitu silinder guna buang, silinder isian semula dan silinder penyimpanan. Silinder guna buang diisikan dengan Bahan Pendingin (Refrigerant) yang biasa digunakan seperti R-134a, R-22, R-404 dan sebagainya dengan berat isian dari beberapa gram hingga ke 13.5 kg. Setelah refrigerant di dalam silinder habis digunakan, silinder guna buang tersebut tidak boleh diisi semula.</p> <p>Silinder isian semula diisi dengan Bahan Pendingin (Refrigerant) antara 2 kg hingga 14 kg. Injap silinder Bahan Pendingin (Refrigerant) jenis ini dilengkapi dengan kembang malar flare 6 mm. Kandungan Bahan Pendingin (Refrigerant) dalam silinder ini boleh ditambah/diisi semula dari silinder penyimpanan. Bagi tujuan keselamatan, pengisian semula yang dilakukan mestilah kurang daripada berat penuh silinder tersebut iaitu antara 75% hingga 80% berat penuh sahaja.</p> <p>Silinder penyimpanan biasanya mengandungi refrigerant seberat 45 kg ke 65 kg. Silinder ini dilengkapi dengan dua injap iaitu injap wap dan injap cecair. Silinder penyimpanan juga dilengkapi dengan pemutup keluli untuk menutup injap silinder.</p> <p>Mengikut peraturan American Society of Heating, Refrigerating and Air - Conditioning Engineers (ASHRAE), silinder simpanan yang tidak dilengkapi dengan injap pelepas (relief valve), berat Bahan Pendingin (Refrigerant) mestilah tidak melebihi dari 150 kg. Selain itu, silinder Bahan Pendingin (Refrigerant) perlulah disimpan di tempat yang selamat dari punca haba.</p> <p>Info Tambahan</p> <p>Halua pemampas jenis silinder Bahan Pendingin (Refrigerant) mestilah injap isian dengan kuantiti Bahan Pendingin (Refrigerant) yang sedikit boleh mengisap halua dengan selamat.</p> <p>Rajah 1.1: Jenis Silinder Bahan Pendingin</p>

The researcher's learning module will incorporate supplementary facts and information sourced from credible and genuine sources.

2. Visual and verbal

2.1 Prinsip Kendalian Sistem Kitaran Asas

Sistem kitaran asas dikendalikan oleh empat komponen asas iaitu:

- Penampat (compressor)
- Pemeluwap (condenser)
- Peranti pemelatan (metering device)
- Perajet (evaporator)

Rajah 2.1: Prinsip Kendalian Sistem Kitaran Asas

Penampat berfungsi untuk menyengap gas tekanan rendah dan rendah sistem penyejukan, ia berfungsi seperti jantung kepada sistem. Penampat akan menyedut gas tekanan dan suhu rendah dari perajet untuk dipampatkan menjadi gas tekanan dan suhu tinggi. Gas tekanan dan suhu tinggi ini akan terus disalurkan ke pemeluwap.

Fungsi pemeluwap pula ialah untuk menyingkikan haba yang diserap oleh bahan pendingin (refrigerant) ke udara luar secara perlahan udara biasa atau secara perlahan udara paksa. Apabila haba dari gas bahan pendingin bertekanan dan suhu tinggi disingkirkan dipemeluwap, bentuk gas bahan pendingin akan berubah kepada cecair bertekanan dan bersuhu tinggi.

Cecair bahan pendingin tekanan dan suhu tinggi ini akan dialirkan ke perajet melalui peranti pemelatan. Peranti pemelatan merupakan komponen yang mengawal kadar aliran cecair bahan pendingin dari bahagian tekanan tinggi ke bahagian tekanan rendah sistem. Selain itu, peranti pemelatan juga berfungsi untuk memuntahkan cecair bahan pendingin supaya hanya menjadi cecair bahan pendingin yang bersuhu rendah sebelum memasuki perajet.

Cecair bahan pendingin bersuhu rendah di dalam perajet akan menyerap haba penyejukan. Proses ini menyebabkan cecair bahan pendingin tersebut akan bertukar menjadi gas bahan pendingin bertekanan dan bersuhu rendah. Gas bahan pendingin tersebut akan disedut semula oleh penampat bagi mengulangi kitaran penyejukan.

The researcher created an instructional module that incorporates visually appealing visuals and diagrams to captivate students' interest. Furthermore, the researcher's learning module incorporates a Quick Response Code (QR Code) to expedite and facilitate students' access to information.

3. Active and reflective

Latihan

- Nyatakan 3 jenis silinder bahan pendingin.
- Nyatakan keselamatan yang perlu diambil kira apabila melabuhkan bahan pendingin.
- Apakah yang dimaksudkan dengan frostbite?
- Terangkan langkah keselamatan sewaktu menggunakan bahan pendingin.
- Berikan definisi pengasingan (isolation), pump down dan pemulihan (recovery).
- Terangkan 3 kaedah pemulihan bahan pendingin di bawah:

Kaedah Pemulihan	Penerangan
Pemulihan Gas	
Pemulihan Cecair & Minyak	
Pemulihan Cecair 'Push and Pull'	

- Jika seseorang Juruteknik tidak menguruskan bahan pendingin dengan betul semasa melakukan servis, apakah tindakan yang perlu dikenakan mengikut Jabatan Alam Sekitar (JAS)?

The researcher's learning module will have a variety of tasks and exercises. The researcher's learning module will facilitate individual or collaborative learning for student.

4. Sequential and global



The generated learning module aligns with the curriculum of Refrigerant Handling topics. Furthermore, the researcher will create an instructional module that is designed to be easily comprehensible for students.

3. Result and Discussion

The researcher has chosen three lecturers who are skilled and have extensive experience in the field of refrigeration and air conditioning from TVET institution to get clear comments and views. This was done to determine the functionality of the learning module in helping SVM students in the field of refrigeration and air conditioning in the teaching and learning process. Table 4 shows the results of the analysis of three experts in the field of refrigeration and air conditioning.

Table 4 Expert demographic analysis

No.	Gender	Education Level	Working Experience	Position
1.	Female	Bachelor's Degree	16-20	Vocational College Teacher
2.	Male	Bachelor's Degree	16-20	Vocational College Teacher
3.	Male	Bachelor's Degree	1-5	Vocational College Teacher

Then, table 5 shows the results of the data obtained for the appropriateness of the content of the module for the learning module Refrigerant Handling for Air Conditioning Systems. The results found that 100% of the experts agreed that the objective of the module was clear. The researcher also found that 100% of the experts agreed that the learning module information is easy to understand. In addition, 100% of experts found that the information was organized in an orderly manner. Next, the language used is easy to understand, agreed by 100% of respondents. For item 5, which is the accompanying diagram, it is clear that only 20% of respondents disagree with the item while 80% of respondents agree that the accompanying diagram is clear. The module can be used independently with 100% approval from respondents. For the data of this module to interest students, the researcher found that 100% of the respondents agreed with the statement. A total of 100% of respondents have agreed that the learning module developed can help strengthen students' basic knowledge. In addition, as many as 100% of respondents have agreed that the content of the module can be adapted according to the needs of the students. Finally, the researcher found that 100% of the experts agreed that the training examples found in the learning module were easy to understand.

Table 5 Result of analysis of suitability of module content

Item	Statement/Question	Percentage (%)	
		Yes	No
1	I agree the objective of the module is clear	100	0
2	I agree that the information provided is easy to understand	100	0
3	I agree that the information is organized in an orderly manner	100	0
4	I agree that the language used is easy to understand	100	0
5	I agree the attached diagram is clear	80	20
6	I agree the attached diagram is clear	100	0
7	I agree that this module is interesting for students	100	0
8	I agree that this module helps strengthen students' basic knowledge	100	0
9	I agree that the content of the module can be adapted according to the needs of the students	100	0
10	I agree the training examples are easy to understand	100	0

Next, table 6 shows the analytical data obtained from the results of the study on the functionality of the learning module for the subject of Refrigerant Handling for Air Conditioning Systems. The researcher found that 100% of the respondents agreed that the learning module developed was suitable for use as a reference. Next, 100% of respondents also agreed that this learning module has the information that users want. In addition, the researcher found that 100% of respondents agreed that the content of this learning module was true and reliable. Next, as many as 100% of respondents have agreed that the activities in the module can attract active student participation. Finally, the researcher found that 100% of respondents agreed that the learning module developed can help improve student knowledge. This proves that the learning module developed by the researcher has a high functionality value and is suitable to be used as a reference for the subject of Refrigerant Handling for Air Conditioning Systems.

Table 6 Result of analysis of module functionality

Item	Statement/Question	Percentage (%)	
		Yes	No
1	I agree the module can be used as a reference	100	0
2	I agree that the module has the required info	100	0
3	I agree that the content of the module is reliable	100	0
4	I agree that the activities in the module can attract active student participation	100	0
5	I agree that this module helps improve students' knowledge	100	0

Furthermore, based on table 7, it shows the analysis data obtained for the design of the learning module for the subject of Refrigerant Handling for Air Conditioning Systems. The researcher found that 100% of respondents agreed that the design of the module used was attractive. In addition, 100% of respondents agreed that the type of writing used in the learning module was appropriate. As for the graphics used by the researcher, as many as 100% of the respondents agreed that the graphics used in the module are appropriate to the content of the module. The selection of suitable colours has also been agreed by 100% of respondents. In addition, 100% of respondents agreed that the size of the writing used in this learning module was appropriate for the presentation of the module. It can be concluded that the design of this learning module can attract respondents to use this learning module as their reference material.

Table 7 Result of analysis of module design

Item	Statement/Question	Percentage (%)	
		Yes	No
1	I agree the module design is interesting	100	0
2	I agree that the type of writing used is appropriate	100	0
3	I agree the graphics used are interesting	100	0
4	I agree that the colour selection used is appropriate	100	0
5	I agree that the text size is appropriate for the presentation of the module	100	0

The absence of efficient instructional materials is a barrier in engaging students' attention during teaching and learning sessions (See et al., 2020). The researcher has examined the necessity of creating a learning module focused on Refrigerant Handling for Air Conditioning Systems, specifically targeting students studying Refrigeration and Air Conditioning. Mingdan, Alias & DeWitt (2020) define modules as printed learning resources that are organised in a systematic manner. Consequently, the researcher has developed this instructional module utilising the Sidek and Jamaluddin Model, which consists of two distinct phases: the module draft preparation phase and the module trial and assessment phase.

A reliable module is one in which users consistently agree that they are able to achieve the learning objectives set by the module and can effectively participate in the recommended activities. Each phase encompasses specific tasks that the researcher must undertake, beginning with establishing goals, examining the module's background, conducting a requirements assessment, setting objectives, selecting material, choosing strategies, and ultimately consolidating the module draft. The produced learning modules adhere to the Vocational College Standard Curriculum (KSKV). Sidek and Jamaluddin's model is an all-encompassing integration model that undergoes a trial phase or pilot research to identify any shortcomings and deficiencies (Yusuf, Abd Rahman & Ghazali, 2021).

Aesthetic-based modules in HVAC education offer a dynamic approach to enhancing learning by incorporating visual appeal, sensory engagement, and emotional connection. These elements work alongside pedagogical strategies to create a more immersive and motivating learning environment, fostering greater cognitive engagement and long-term knowledge retention (Barton, 2023). By catering to diverse learning styles, such modules make complex HVAC concepts more accessible, encouraging deeper comprehension and practical application. This fusion of aesthetics and pedagogy not only improves the overall learning experience but also enhances teaching effectiveness, contributing to better educational outcomes in the TVET sector.

Fitria (2022) states that when lecturers or instructors fail to tailor their teaching to students' learning styles, it can lead to students feeling uncomfortable and inattentive during the teaching and learning session. Consequently, the researcher has developed a learning module based on the Felder-Silverman learning style, sometimes referred to as the Felder-Silverman Learning Style Dimensions (FSLSM), which provides a comprehensive description of learning. This learning style is categorised into four dimensions: perception (sensing and intuitive), input (visual and verbal), processing (active and reflective), and understanding (sequential and global). Felder & Solomon (2012) assert that pupils who actively engage with knowledge have a greater comprehension of it. Hence, the researcher's choice of the learning module design is suitable for fostering active student engagement in the teaching and learning process.

The researcher employed the Sidek and Jamaluddin Model as a framework to develop this instructional module, as described earlier. The module development procedure in this technique involves two separate phases that researchers must complete: an initial phase of drafting the module and a subsequent phase of testing and evaluating its effectiveness. The researcher chose SVM students with a specialisation in Refrigeration and Air Conditioning as the target audience for this learning module during its development. Therefore, the researcher has developed the educational module in alignment with KSKV. In addition, the researcher meticulously designed the learning module, taking into account the order in which the content is presented, as well as the arrangement of text and graphics within the module. Teaching aids that are well-structured and methodical can boost the effectiveness of the teaching and learning process (Ngao, Sang & Kihwele, 2022).

Butler & Yuill (2021) found that the learning module for Maintenance of Heating, Ventilation, and Commercial Air Conditioning lacks adequate visual representations, particularly diagrams. As a result, the researcher created an educational module that included clear pictures for each topic, making it easier for users to understand the content of the module. The learning methodology utilised in the development of this instructional module greatly enhances its efficacy as an educational resource for teaching and learning sessions. The researcher opts to employ the Felder-Silverman learning style during the development phase of this learning module. The researcher utilises the Felder-Silverman learning style because it aligns well with the teaching aids created by the researcher. These aids incorporate many media elements, such as text, graphics, QR codes that direct users to relevant websites, and appropriate colours to engage the user's attention. According to Roberts (2022), employing appealing graphics,

characterised by brilliant colours and adept colour blending, has the capacity to captivate pupils' interest. Darejeh, Mashayekh & Marcus (2022) further argued that the software's focus on multimedia components, such as sound, graphics, diagrams, animations, and colourful pictures, can improve students' cognitive, psychomotor, interest, and behavioural results. The main purpose of developing this instructional module is to aid instructors and learners in their pedagogical and educational pursuits. The proposed learning module functions as both instructional aids and an information source for students. The employment of this instructional module can also be seen as a beneficial approach, and its flexibility allows users to gain various benefits based on their needs and preferences.

The effectiveness of the learning module is a critical aspect in this study. The researcher evaluated the effectiveness of the developed learning module to determine if SVM TVET institution students specialising in Refrigeration and Air Conditioning could use it effectively for their educational needs. Davis & Wilcock (2003) evaluate the need and importance of developing instructional tools and constructing teaching aid modules by studying how usable and understandable they are for stakeholders who use them for teaching and learning. Therefore, the researcher collected feedback and ideas to improve the generated learning module by delivering questionnaires to three instructors who specialise in Refrigeration and Air Conditioning at the TVET university.

The study's research focuses on the effectiveness of the learning module, revealing that the respondents agree, resulting in a high level of performance. The researcher performed a data analysis by tabulating the participants' responses into a table that encompassed descriptions, percentages, and frequencies. The researcher can obtain diverse insights from the data included in the table concerning the effectiveness of this learning module. These insights relate to the appropriateness of the module's content, its operation, and design, as well as suggestions for improving the learning module.

All participants expressed positive comments and unanimously agreed that the generated learning module was both easy to use and effective. Most studies have consistently found that the use of multimedia has a positive effect on the pedagogical process of teaching and learning. According to Haleem et al. (2022), using media in a creative way can speed up and improve the effectiveness of learning, hence helping to achieve learning goals successfully. Furthermore, the analysis carried out on the functionality aspect of this learning module clearly shows its outstanding performance and its successful achievement of the objective to support the instructor in the teaching and learning process for the subject of Refrigerant Handling for Air Conditioning Systems. The favourable impressions of the respondents suggest that the integration of teaching and learning approaches can increase the attractiveness of educational activities. The functionality of the module is essential for ensuring the effectiveness and relevance of this learning module for both instructors and students throughout the teaching and learning process (Dewi & Primayana, 2019).

The integration of aesthetics in HVAC learning modules enhances the educational experience by combining visual, sensory, and emotional elements with pedagogical strategies. This approach not only makes technical content more engaging and accessible but also improves cognitive engagement, motivation, and knowledge retention among learners (Shih, 2020). By aligning with diverse learning styles, the aesthetically designed module fosters deeper understanding and practical application of complex HVAC concepts. Ultimately, this method enhances both teaching effectiveness and learner outcomes, making it a valuable advancement in HVAC education within the TVET framework.

4. Conclusion

Through thorough study and research, the researcher has determined that the primary objective of creating a learning module for the proper use of refrigerants in air conditioning systems may really be accomplished. Furthermore, the creation of this learning module is a beneficial aspect of the Teaching and learning process. The designed learning module serves as a valuable reference for students and teachers in the Refrigeration and Air Conditioning industry, providing them with significant benefits. The creation of the Refrigerant Handling Learning Module for Air Conditioning System involves establishing research goals and utilizing a literature analysis to identify the most effective components to incorporate into the content of this educational module. Ultimately, it is anticipated that the created learning module will be advantageous and yield favourable outcomes in terms of teaching and learning effectiveness for its users.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: Shen Wen: Literature review, methodology, data collection and project administration. Faizal Amin Nur Yunus: Drafted the manuscript and provided substantial revisions formal analysis, and validation. Contributed to writing the results and discussion sections, conceptualization, methodology and resources. Suhaizal Hashim: Conceptualization, methodology and resources.

References

- Al Mamun, M. A., & Lawrie, G. (2023). Student-content interactions: Exploring behavioural engagement with self-regulated inquiry-based online learning modules. *Smart Learning Environments*, 10(1), 1.
- Alzaanin, E. (2023). Uncovering University Teachers' Perspectives: Conceptualizations, Factors, and Perceptions of Second Language Learner Engagement. *Qualitative Report*, 28(8).
- Bakar, A. Y. A. (2023). Fulfilling the Aspirations of Malaysian Education Blueprint 2013-2025: Issues and Challenges. *Journal for ReAttach Therapy and Developmental Diversities*, 6(6s), 13-17.
- Barton, G. (2023). The importance of aesthetics in educational spaces and relationships. In *Aesthetic Literacies in School and Work: New Pathways for Education* (pp. 69-81). Singapore: Springer Nature Singapore.
- Butler, J., & Yuill, D. P. (2021). Experiential learning for teaching heating, ventilation, and air-conditioning engineering. In *2021 IEEE Frontiers in Education Conference (FIE)* (pp. 1-5). IEEE.
- Darejeh, A., Mashayekh, S., & Marcus, N. (2022). Cognitive-based methods to facilitate learning of software applications via E-learning systems. *Cogent Education*, 9(1), 2082085.
- Davis, C., & Wilcock, E. (2003). Teaching materials using case studies. C. Baillie (Series Ed.), *The UK Centre for Materials Education*. Retrieved from <http://www.materials.ac.uk/guides/1-casestudies.pdf>.
- Dewi, P. Y., & Primayana, K. H. (2019). Effect of learning module with setting contextual teaching and learning to increase the understanding of concepts. *International Journal of Education and Learning*, 1(1), 19-26.
- Egan, A. K. (2021). Understanding aesthetics in design education. In *DS 110: Proceedings of the 23rd International Conference on Engineering and Product Design Education (E&PDE 2021)*, VIA Design, VIA University in Herning, Denmark. 9th-10th September 2021. The Design Society.
- Felder RM, Soloman BA (2012) Learning styles and strategies. [Cited 20/10/2012]. Available from: <http://www4.ncsu.edu/unity/lockers/users/f/felder/public/ILSdir/styles.htm>.
- Felder, R. M., & Silverman, L. K. (1988). Learning and teaching styles in engineering education. *Engineer. Education*, 78(7), 674-681. Preceded by a preface in 2002: <http://www.ncsu.edu/felderpublic/PapersILS-1988.pdf>
- Filgona, J., Sakiyo, J., Gwany, D. M., & Okoronka, A. U. (2020). Motivation in learning. *Asian Journal of Education and social studies*, 10(4), 16-37.
- Fitria, T. N. (2022). Microlearning in teaching and learning process: A review. *CENDEKIA: Jurnal Ilmu Sosial, Bahasa Dan Pendidikan*, 2(4), 114-135.
- Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, 3, 275-285.
- Hamzah, H., Hamzah, M. I., & Zulkifli, H. (2022). Systematic Literature review on the elements of metacognition-based Higher Order Thinking Skills (HOTS) teaching and learning modules. *Sustainability*, 14(2), 813.
- Haniah, A. R., Aman, A., & Setiawan, R. (2020). Integration of strengthening of character education and higher order thinking skills in history learning. *Journal of Education and Learning (EduLearn)*, 14(2), 183-190.
- Hashim, S., Rahman, K. A. A., Saimi, M. A. N., Baharudin, N., Salleh, M. M., Nincarean, D., & Maneetien, N. (2022). Comprehensive Simulation of Adjustable Welding Jig through ASIE Model in Refrigeration and Air Conditioning Workshop. *International Journal of Nanoelectronics & Materials*, 15.

- Isal, R., Santoso, H., & Novandi, E. (2021). Development and evaluation of a mobile-learning application based on the felder-silverman learning styles model. *International Journal of Emerging Technologies in Learning (ijET)*, 16(15), 107-124.
- Jensen, B., Whiting, E. F., Hernández, J., Zhang, X., Pliego, D., & Sudweeks, R. (2023). Becoming equitable educators: Practical measures to support teachers' dispositional growth. *Journal of Teacher Education*, 74(4), 299-314.
- Liang, Z., da Costa Junior, M. G., & Piumarta, I. (2020). Opportunities for improving the learning/teaching experience in a virtual online environment. In *2020 IEEE International Conference on Teaching, Assessment, and Learning for Engineering (TAL)* (pp. 243-250). IEEE.
- Logan, R. M., Johnson, C. E., & Worsham, J. W. (2021). Development of an e-learning module to facilitate student learning and outcomes. *Teaching and Learning in Nursing*, 16(2), 139-142
- Marini, G. (2021). An introduction to everyday aesthetics in education. *Studies in Philosophy and Education*, 40(1), 39-50.
- Mesuwini, J., & Mokoena, S. P. (2023). TVET Lecturer Work-Integrated Learning: Opportunities and Challenges. *International Journal of Learning, Teaching and Educational Research*, 22(8), 415-440.
- Meyer, M. W., & Norman, D. (2020). Changing design education for the 21st century. *She Ji: The Journal of Design, Economics, and Innovation*, 6(1), 13-49.
- Mingdan, L., Alias, N., & DeWitt, D. (2020). The Development of Technical Communication Module for TVET Students in China. *Journal of Issue in Education*, 43, 1-11.
- Munna, A. S., & Kalam, M. A. (2021). Teaching and learning process to enhance teaching effectiveness: a literature review. *International Journal of Humanities and Innovation (IJHI)*, 4(1), 1-4.
- Ngao, A. I., Sang, G., & Kihwele, J. E. (2022). Understanding teacher educators' perceptions and practices about ICT integration in teacher education program. *Education Sciences*, 12(8), 549.
- Ramamurthy, V., DeWitt, D., & Alias, N. (2021). The Need for Technical Communication Pedagogical Module For 21st Century Learning in TVET Institutions: Lecturers' typical Instructional Strategies. *MOJES: Malaysian Online Journal of Educational Sciences*, 9(3), 37-46.
- Ritchie, J., Lewis, J., & Elam, R. G. (2013). Selecting samples. *Qualitative research practice: A guide for social science students and researchers*, 111.
- Roberts, J. C. (2022). Active Learning Activities in a Collaborative Teacher Setting in Colours, Design and Visualisation. *Computers*, 11(5), 68.
- Saharudin, M. S., Nahran, S. A., Nasir, N. A. C., Azli, M. S. M. N., & Muhamad, W. M. W. Prospect, Issues, And Challenges in Malaysia TVET-Based Education. on *Advancing and Redesigning Education*.
- See, B. H., Morris, R., Gorard, S., & El Soufi, N. (2020). What works in attracting and retaining teachers in challenging schools and areas? *Oxford Review of Education*, 46(6), 678-697.
- Shih, Y. H. (2020). Teaching Principles for Aesthetic Education: Cultivating Taiwanese Children's Aesthetic Literacy. *International Journal of Education and Practice*, 8(3), 568-576.
- Shaffie, M. A., Yunus, F. A. N., Rahim, M. B., Razali, M. N., & Rahman, K. A. A. (2022). Web Development for HVAC Water Treatment Module. *Research and Innovation in Technical and Vocational Education and Training*, 2(2), 250-256.
- Sidek Mohd Noah, Jamaludin Ahmad (2005). *Building Modules: How to Build Training Modules and Academic Modules*. *Pembinaan Modul: Bagaimana Membina Modul Latihan dan Modul Akademik*. Serdang: Universiti Putra Malaysia
- Silvia, F., Astuti, M., & Dewi, S. M. (2023). Development of Professional Ethics and Aesthetics E-Modules Based on Problem Based Learning to Improve Students' Critical Thinking Ability. *Jurnal Teknologi Pendidikan: Jurnal Penelitian dan Pengembangan Pembelajaran*, 8(3), 640-653.
- Stanley, T. (2021). *Authentic learning: real-world experiences that build 21st-century skills*. Routledge.
- Tathahira, T. (2020). Promoting students' critical thinking through online learning in higher education: Challenges and strategies. *Englisia: Journal of Language, Education, and Humanities*, 8(1), 79-92.
- Wolterinck, C., Poortman, C., Schildkamp, K., & Visscher, A. (2022). Assessment for Learning: developing the required teacher competencies. *European Journal of Teacher Education*, 1-19.

- Yan, H., & Guo, J. (2023). Design and implementation of HVAC laboratory based on co-simulation. In 2023 2nd International Symposium on Sensor Technology and Control (ISSTC) (pp. 226-231). IEEE.
- Yusuf, N. M., Abd Rahman, N., & Ghazali, N. (2021). The Effect of a Technology-Enhanced Learning (TEL) Module on the Achievement of Form Four Students in the Topic of Waves and Sound. *Jurnal Pendidikan Sains Dan Matematik Malaysia*, 11, 81-93.