

# Mastering the Art of TVET instruction: Pedagogy, Module and Design Essentials

Suhaizal Hashim<sup>a\*</sup>, Nurhani Khamis<sup>a</sup>, Khairul Anuar Abdul Rahman<sup>b</sup>, Noor Hidayah Che Lah<sup>c</sup>

<sup>a</sup>Faculty of Technical and Vocational Education, Universiti Tun Hussein Onn Malaysia, 86400 Batu Pahat, Johor, Malaysia

<sup>b</sup>Department of Advanced Technical and Vocational Education and Training, Faculty of Educational Sciences and Technology  
Universiti Teknologi Malaysia, 81300 UTM Johor Bahru, Malaysia

<sup>c</sup>Faculty Of Computing and Meta-Technology, Universiti Pendidikan Sultan Idris Tanjung Malim, 35900, Perak, Malaysia

\*Corresponding author: [suhaizal@uthm.edu.my](mailto:suhaizal@uthm.edu.my)

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## Abstract

The area of education has swiftly expanded, especially in teaching and learning methodologies, which today encompass more than merely the concepts and curriculum of education. Modules are frequently employed in technical disciplines to augment knowledge and abilities within the teaching and learning framework, especially in Heating, Ventilation, and Air Conditioning (HVAC), a critical domain in Technical and Vocational Education and Training (TVET). The current HVAC learning module fails to adequately engage cognitive processes, impeding learners' deep comprehension and recall of essential concepts. The primary aim of this project is to design, develop, and assess the efficacy of the Refrigerant Handling Learning Module for Air Conditioning Systems. The module's design adhered to the Sidek and Jamaluddin Model, which consists of two stages and eight processes that must be executed during the development of the learning module. This curriculum has been developed utilising the Felder-Silverman learning style as a pedagogical approach. This study utilises a quantitative methodology with a questionnaire as the research instrument. Three seasoned professionals in the Refrigeration and Air Conditioning sector offered insights on the evaluation of the created learning module. The questionnaire assesses three primary aspects: the appropriateness of module content, module design, and module functionality. The analysis of the questionnaire will be presented as a percentage. The study concluded that the development of the learning module met its aims and was considered satisfactory. The researcher's learning module aims to enhance the effectiveness and efficiency of educators and learners in the educational process. Ultimately, the developed learning module is expected to be beneficial and produce positive results regarding teaching and learning efficacy for its users.

**Keywords:** Learning Module, Pedagogical approach, Technical and Vocational Education and Training (TVET)

## Abstrak

Bidang pendidikan telah berkembang pesat, terutamanya dalam metodologi pengajaran dan pembelajaran, yang kini merangkumi lebih daripada sekadar konsep dan kurikulum pendidikan. Modul sering digunakan dalam disiplin teknikal untuk meningkatkan pengetahuan dan kebolehan dalam kerangka pengajaran dan pembelajaran, terutamanya dalam Pemanasan, Pengudaraan dan Penyaman Udara (HVAC), domain kritikal dalam Pendidikan dan Latihan Teknikal dan Vokasional (TVET). Modul pembelajaran HVAC semasa gagal melibatkan proses kognitif dengan secukupnya, menghalang pemahaman mendalam pelajar dan mengingat semula konsep penting. Tujuan utama projek ini adalah untuk mereka bentuk, membangun dan menilai keberkesanan Modul Pembelajaran Pengendalian Bahan Penyejuk untuk Sistem Penyaman Udara. Reka bentuk modul ini mematuhi Model Sidek dan Jamaluddin, yang terdiri daripada dua peringkat dan lapan proses yang mesti dilaksanakan semasa pembangunan modul pembelajaran. Kurikulum ini telah dibangunkan menggunakan gaya pembelajaran Felder-Silverman sebagai pendekatan pedagogi. Kajian ini menggunakan metodologi kuantitatif dengan soal selidik sebagai instrumen penyelidikan. Tiga profesional berpengalaman dalam sektor Penyejukan dan Penyaman Udara menawarkan pandangan tentang penilaian modul pembelajaran yang dicipta. Soal selidik ini menilai tiga aspek utama: kesesuaian kandungan modul, reka bentuk modul dan fungsi modul. Analisis soal selidik akan dibentangkan sebagai peratusan. Kajian ini menyimpulkan bahawa pembangunan modul pembelajaran telah mencapai matlamatnya dan dianggap memuaskan. Modul pembelajaran penyelidikan bertujuan untuk meningkatkan keberkesanan dan kecekapan pendidik dan pelajar dalam proses pendidikan. Akhirnya, modul pembelajaran yang dibangunkan dijangka bermanfaat dan menghasilkan keputusan positif mengenai keberkesanan pengajaran dan pembelajaran untuk penganungnya.

**Kata kunci:** Modul Pembelajaran, Pendekatan Pedagogi, Pendidikan dan Latihan Teknikal dan Vokasional (TVET)

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## 1.0 INTRODUCTION

The evolution of the contemporary education sector has experienced numerous modifications to address the requirements and expectations of an evolving society. Initiatives to enhance the education system seek to align the quality of education in Malaysia with global norms. The Malaysian government has undertaken several attempts to synchronise national education standards with international benchmarks, as detailed in the Malaysian Education Blueprint (2013–2025) (Bakar, 2023). At the tertiary education level, students must not only acquire foundational cognitive skills but also develop advanced cognitive abilities to engage effectively in progressively demanding learning activities in the contemporary era (Haniah, Aman, & Setiawan, 2020).

The utilisation of innovative and practical instructional materials has been shown to enhance student engagement and motivation in educational settings. This strategy is perceived as more effective than traditional methods, which are becoming increasingly obsolete. Jensen et al. (2023) underscored the necessity for educators to maintain a professional demeanour and strong dedication to guarantee the efficacy of the instructional process and the superiority of delivery techniques. Consequently, the function of educators is crucial in influencing the results of the learning process.

Filgona et al. (2020) assert that the creation of teaching aids can assist educators in diversifying instructional tactics to sustain student attention and engagement in a subject. Consequently, educators must meticulously assess and strategise instructional methods to attain the established learning objectives. To foster experience learning, instructors must employ innovative strategies, such as Active Blended Learning. Teaching aids, such as modules, have been shown to efficiently facilitate the integration of theory and practice (Hamzah, Hamzah, & Zulkifli, 2022), while also cultivating proficient students who fulfil contemporary industrial requirements. Moreover, the implementation of modules grounded in a robust pedagogical framework enhances student creativity (Logan, Johnson, & Worsham, 2021).

Currently, learning modules are extensively utilised as educational instruments. Modules are non-electronic instructional tools grounded in analogue technology; however, they remain pertinent in facilitating student-centered self-directed learning without total reliance on educators. Throughout the educational process, both educators and students encounter numerous problems. The utilisation of suboptimal educational resources and unengaging instructional materials may adversely impact student attendance and interest in learning sessions (Saharudin et al., 2021). Moreover, conventional pedagogical methods, such the overreliance on whiteboards and teacher-centric strategies, persist (Liang, da Costa Junior, & Piumarta, 2020), hence impeding students' cognitive growth as they become passive and excessively reliant on instructor elucidations.

The utilisation of learning modules is regarded as an efficient method for enhancing student comprehension and performance. Osman and Hamzah (2016) asserted that the efficacy of instruction relies on various critical components, including subject matter, instructional materials, pedagogical approaches, and the teachers' proficiency in knowledge and abilities. Ismail and Moskam (2017) highlighted that learning modules serve as an excellent medium for facilitating students' methodical comprehension of educational content. The efficacy of the modules is also contingent upon the skill levels of the pupils. Variations in cognitive abilities and skill sets result in certain students successfully adapting to academic assignments, while others encounter challenges, hence impacting their self-esteem (Ramamurthy, DeWitt, & Alias, 2021).

Moreover, Stanley (2021) contends that many pedagogical approaches applied in the classroom are ambiguous and misaligned with the realities of the professional environment, ultimately impacting students' comprehension of learning results. Preliminary research was undertaken to assess the learning module for the subject of Refrigerant Handling based on this concern. This research included interviews with the coordinator of the Refrigeration and Air Conditioning Program at a Technical and Vocational Education and Training (TVET) institution. The preliminary study's findings indicated that the current modules were not explicitly designed to address the requirements of educators and learners in the domain. Students pursuing the Malaysian Vocational Certificate (SVM) in Refrigeration and Air Conditioning have challenges in comprehending and implementing academic and practical principles predominantly derived from external sources. In the realm of TVET, which prioritises practical skills, educators frequently employ demonstration tactics to impart knowledge and abilities. This method is limited by time restrictions and challenges in reproducibility (Yan & Guo, 2023). Consequently, the implementation of the Felder-Silverman learning style is regarded as suitable for the creation of more effective learning modules (Isal, Santoso & Novandi, 2021).

The application of dynamic and interactive pedagogical practices can enhance student engagement and assist learners with low cognitive abilities in comprehending intricate concepts (Tathahira, 2020). Consequently, the creation of a learning module for the Refrigerant Handling subject is essential as a pedagogical tool to enhance the efficacy of the teaching and learning process. This module is anticipated to enhance academic performance and skill proficiency among SVM students in Refrigeration and Air Conditioning. This session enables students to master refrigerant management at their own pace and in a flexible manner. Utilising modules enables students to construct their own framework of comprehension to grasp new concepts in the learning process (Shaffie et al., 2022).

## ■ 2.0 LITERATURE REVIEW

Meyer and Norman (2020) asserted that everyone had distinct demands, resulting in variability regarding information, cognitive capacities, behaviours, and learning modalities. Effective teaching approaches in education inspire active student participation and enhance comprehension of learnt concepts, hence improving academic performance. Learning styles and educational disciplines pertain to the methodologies employed by educators to impart knowledge to pupils, encompassing the processes of learning, gathering, analysing, and comprehending facts to construct understanding (Wolterinck et al., 2019).

The lack of a learning module for the Refrigerant Handling subject was recognised as a significant limitation for students in the Refrigeration and Air Conditioning sector within TVET universities. Students encounter challenges in acquiring suitable and organised reference materials, so hindering a thorough comprehension of the educational subject. The absence of a coordinated knowledge dissemination system complicates the mastery of information. Proficient refrigerant handling abilities are essential for students to effectively utilise this knowledge in their future professions and fulfil the demands of the Heating, Ventilation, and Air Conditioning (HVAC) business. Moreover, time limitations in the educational process impact student comprehension, particularly within the realm of TVET, which prioritises a balance between theoretical knowledge and practical application (Mesuwini & Mokoena, 2023).

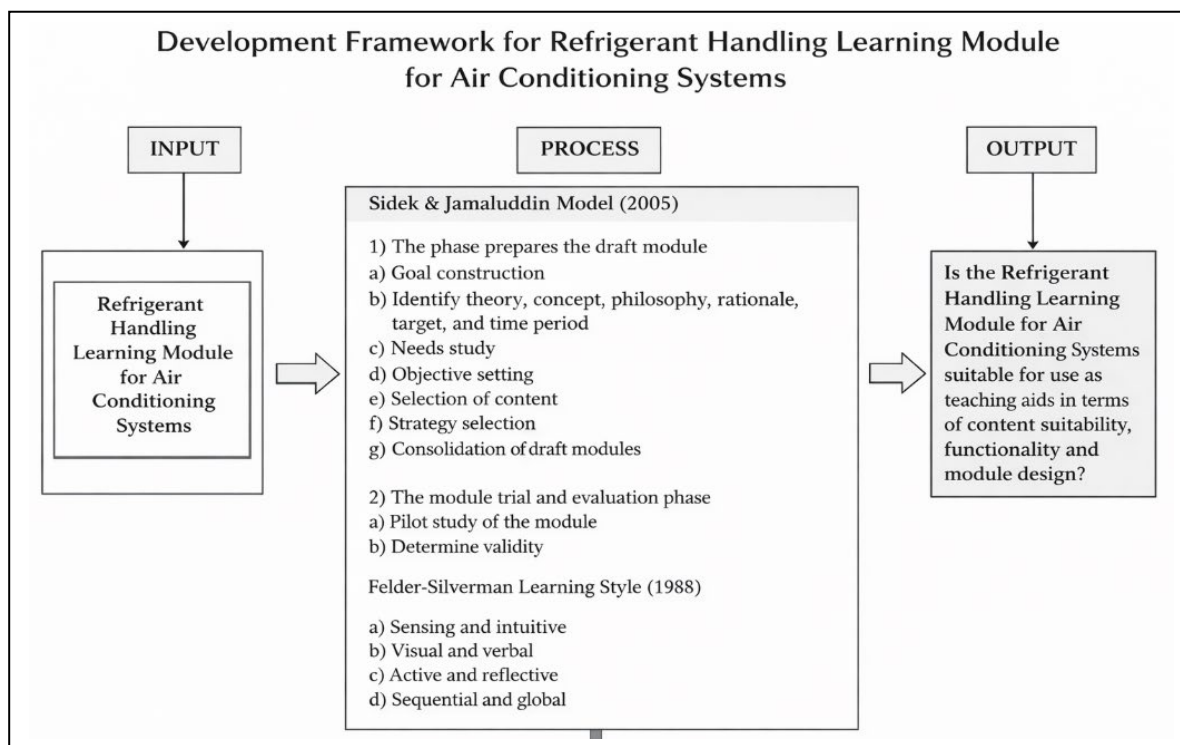
This condition additionally compels pupils to encounter challenges in executing practical actions pertaining to Refrigerant Handling with precision and efficacy (Hashim et al., 2022). In this context, numerous educational methodologies have been implemented to enhance the quality and efficacy of the learning process. The utilisation of learning modules serves as the primary reference resource in the execution of instruction. The utilisation of modules can enhance teaching efficacy in the classroom and facilitate the clear, organised, and

systematic conveyance of knowledge to pupils. Consequently, the creation and utilisation of learning modules is essential for aiding students in reviewing and reinforcing their comprehension of challenging subjects.

Prior research has introduced multiple learning style frameworks, including those of Kolb, Dunn and Dunn, Felder-Silverman, and visual-auditory modalities. Felder and Silverman (1988) highlighted that individuals possess distinct learning styles based on their internal and external capacities for receiving, processing, and comprehending information. Students can synthesise information in diverse formats through data analysis, facts, and algorithms. Some students comprehend concepts more effectively through theoretical or model-based presentations, while others prefer visual stimuli, such as graphics and charts, or verbal stimuli via oral explanations. Munna and Kalam (2021) asserted that using visual aspects in educational materials enhances student comprehension, according with cognitive theory, which highlights the significance of visuals in reinforcing memory.

A learning model denotes a conceptual framework that elucidates the methodology employed in imparting knowledge to students. This framework encompasses diverse tactics, procedures, and methodologies designed to enhance students' comprehension, abilities, and engagement in the educational process (Alzaanin, 2023). In this context, learning modules serve as a medium that facilitates self-directed learning, enabling students to absorb knowledge both in the classroom and independently, without total reliance on instructors. Al Mamun and Lawrie (2023) assert that learning modules must be methodically and aesthetically developed to engage students' interest in active participation and comprehension of the subject. Systematised knowledge enables pupils to attain learning objectives with greater efficacy. Consequently, module development must be executed meticulously, considering the attributes of high-quality modules that align with user requirements.

In the realm of module development, Sidek Mohd Noah (2005) proposed the Sidek and Jamaluddin Module Development Model, comprising two primary phases: the module construction phase and the module assessment and validation phase. The initial step entails creating a preliminary draft of the module according to established objectives, whilst the subsequent phase emphasises the evaluation and enhancement of the module generated. Both steps are crucial for guaranteeing the production of high-quality, methodical, and effective modules. This study selected the Sidek and Jamaluddin Model (2005) as the primary framework for developing the Refrigerant Handling Learning Module. This model is suitable as it offers a thorough development framework and facilitates the creation of modules that address the requirements of SVM students in Refrigeration and Air Conditioning at TVET institutions. A conceptual framework was established, as seen in Figure 1, to thoroughly elucidate the process of creating this learning module and its constituent elements.



**Figure 1** A Conceptual Framework Underpinning the Design and Development of a Learning Module on Refrigerant Handling in Air Conditioning System

The primary purpose of developing this learning module is to equip Vocational Malaysia Certificate (SVM) students specialising in Refrigeration and Air Conditioning with a comprehensive mastery of refrigerant handling. Furthermore, the module aims to enhance students' theoretical and practical understanding of the subject matter. Consequently, the specific objectives of this study are to:

- 1; Design a Refrigerant Handling Learning Module for air conditioning systems.
2. Develop the Refrigerant Handling Learning Module based on the Sidek and Jamaluddin Module Development Model.
3. Evaluate the functionality of the developed Refrigerant Handling Learning Module.

### ■3.0 METHODOLOGY

The research design is a fundamental component of any study, serving as a strategic roadmap to ensure the successful attainment of research objectives and the systematic addressing of research questions. This study adopts a quantitative approach within a developmental research framework, commonly referred to as Design and Development Research (DDR). The primary goal is to strategize the creation of an advanced blended learning module specifically tailored for the topic of Refrigerant Handling. The researcher has selected the Sidek and Jamaluddin (2005) Model, which comprises two distinct phases:

1. Phase I: Draft module preparation.
2. Phase II: Module testing and evaluation.

This model was chosen due to its robust and systematic methodology for module construction, which offers a more comprehensive process compared to alternative development frameworks.

#### 3.1 Sampling

The target population for this study consists of vocational instructors specialising in Refrigeration and Air Conditioning Technology within Technical and Vocational Education and Training (TVET) institutions in Johor, specifically those teaching the SVM curriculum. The study utilises a purposive sampling method, which involves the deliberate selection of participants who possess specific characteristics relevant to the research (Ritchie, Lewis & Elam, 2013). Given the specialised nature of the evaluation, the sample comprises three expert instructors from a TVET institution in Johor. The researcher established stringent criteria for the selection of these respondents to ensure data validity. The prerequisites for inclusion include:

1. A minimum of five years of professional teaching experience in the field.
2. Active involvement or current engagement with the refrigeration and air conditioning industry.

#### 3.2 Data Analysis

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, to generate research findings that are both legitimate and credible.

**Table 1** Formula for Total Assessment Scores

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

The researchers designated three specialists, comprising lecturers in Refrigeration and Air Conditioning from TVET colleges in Johor, for module validation. The study instrument employed was a checklist comprising four primary sections: expert demographic data (Section A), ten elements assessing module content compatibility (Section B), five items regarding module functionality (Section C), and five things related to module design (Section D). The assessment of this instrument employed a dichotomous scale ("Yes" or "No") to streamline data collection and enhance the precision of the respondent's opinion. The degree of expert consensus was subsequently assessed by percentage calculations based on score values ranging from 0% to 100%, so offering an objective representation of agreement regarding the quality of the generated module.

#### 3.3 Product Design

The creation of high-quality learning modules necessitates a strong theoretical framework to guarantee methodological precision and content coherence during the design process. This study employs the Module Development Model by Sidek and Jamaluddin (2005) as a systematic framework for creating complete and impactful educational materials. This model comprises two primary phases: the initial phase entails the preparation of a module draft through nine systematic steps, commencing with goal setting and culminating in draft consolidation. The subsequent phase emphasises testing and evaluation via pilot studies to ascertain the module's validity and reliability. Figure 2 demonstrates that this two-phase strategy provides a foundational structure, ensuring that each development stage is executed systematically to yield a module that satisfies academic criteria and user requirements.

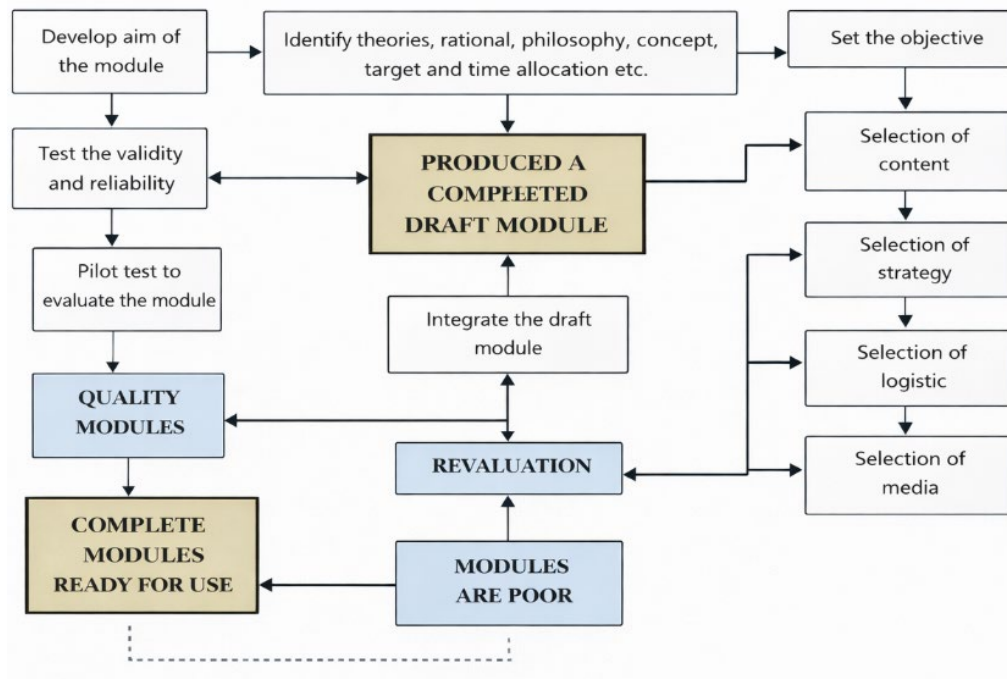


Figure 2 Sidek & Jamaluddin model (2005)

i. The phase prepares the draft module

The process of drafting the module encompasses a series of methodical processes, commencing with goal formulation and concluding with the revision of the draft module. This stage is referred to as the initial development phase of the module, during which the module has not yet undergone validation and evaluation by experts. This phase encompasses various critical operations in the development of the Refrigerant Handling Learning Module for Air Conditioning Systems.

ii. Goal construction

During this phase, the researcher must ascertain the target demographic that will utilise the developed learning module. The intended audience for this module comprises Malaysian Vocational Certificate (SVM) students enrolled in the Refrigeration and Air Conditioning program in TVET institutions. A requirements analysis is conducted to ascertain the root causes of the current issues. The original analysis revealed that TVET colleges lack a dedicated learning module for Refrigerant Handling. Consequently, the researcher aimed to create a learning module and evaluate its appropriateness.

iii. Identify the background of the module

This step entails ascertaining the module's background, encompassing theoretical elements, concepts, philosophy, justification, target demographic, and development timeline. The researcher must ascertain suitable learning theories in accordance with curricular specifications. The rationale for the creation of this module underscores the significance of Refrigerant Handling in Air Conditioning Systems. The module's philosophy is founded on educational principles that facilitate active engagement between educators and learners. The methodology employed is thorough to guarantee that the module material encompasses both academic and practical dimensions comprehensively. The duration of module development is contingent upon the capacity to provide a high-quality module that fulfils the requirements of the target users, namely SVM students in Refrigeration and Air Conditioning.

iv. Needs study

Prior to the implementation of the module's development, the researcher conducted a preliminary investigation to gather essential information. The results indicated that TVET universities do not offer supplementary learning modules explicitly addressing Refrigerant Handling in Air Conditioning Systems. Consequently, the researcher recognised the necessity to create a complete learning module aligned with the Vocational College Standard Curriculum (KSKV).

iv. Objective setting

The establishment of module objectives is based on cognitive domains as outlined in Bloom's Taxonomy. The module objectives aligned with KSKV encompass students' capacity to recognise the procedure for disassembling refrigeration system components for repair, methodically execute work protocols, and identify techniques for refrigerant recovery.

## vi. Content selection

During this phase, researchers restrict content selection to pertinent themes and methodically categorise them according to subtopics to be incorporated into the 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 Systems	- Isolation
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 choice of learning strategies in the creation of this module is grounded in the cognitive learning theory framework. This method seeks to enhance students' comprehension of learning material by employing visual elements, including diagrams and pictures, to complement information presentation.

## viii. Consolidate draft modules

This phase seeks to integrate all module components, including lesson plans and educational materials. Diverse media are utilised to enhance the teaching and learning process, including the compilation of pertinent documentation. Prior to the comprehensive deployment of this module, it underwent preliminary testing to ascertain its usability and reliability for intended users.

## ix. The module trial and evaluation phase

The module's trial and evaluation phase

The module evaluation and testing process is conducted to ascertain if the produced learning module satisfies the standards established for SVM students in Refrigeration and Air Conditioning at TVET colleges. Furthermore, an evaluation is conducted to ascertain the clarity of instructions, the appropriateness of the questions presented, and the adequacy of the questionnaire instrument utilised for expert verification.

**3.4 Module Design Based On Felder-Silverman Learning Style**

The development of this module is based on five main pedagogical approaches, namely constructivism, collaborative, reflective, integrative, and inquiry based. Specifically, the constructivist approach in this module is integrated with the Felder-Silverman Learning Styles Model, which emphasizes that students actively construct understanding through the synthesis of new information with existing experiences. This model classifies learning tendencies into four main dimensions, namely sensing/intuitive, visual/verbal, active/reflective, and sequential/global. The integration of this framework allows the module to accommodate students' cognitive diversity, thus facilitating the process of transforming information into deep knowledge and understanding. Table 3 shows the module design and description based on Felder-Silverman learning style.

**Table 3** Module design and description based on Felder-Silverman learning style

No	Design	Description
1.	Sensing and intuitive	The instructional module integrates supplementary empirical data and information derived from authoritative sources. This approach aligns with the Sensing dimension of the Felder-Silverman Learning Style Model (FSLSM), which prioritizes concrete evidence and practical information to enhance the learner's understanding of real-world applications
2.	Visual and verbal	To accommodate Visual learners, the module incorporates strategically designed diagrams and graphical representations aimed at increasing cognitive engagement. Furthermore, the integration of Quick Response (QR) codes facilitates rapid access to information, supporting a seamless and interactive learning experience
3.	Active and reflective	The module features a diverse array of tasks and exercises designed to balance the Active and Reflective learning dimensions. These activities are structured to support both collaborative group dynamics and independent, self-paced analytical processing.
4.	Sequential and global	The module's content is systematically aligned with the Refrigerant Handling curriculum to ensure a logical, Sequential progression of concepts. This structured design is intended to improve comprehensibility while providing the necessary framework for Global learners to synthesize complex technical topics effectively.

#### ■4.0 RESULTS

To guarantee the validity and quality of the findings, the researchers engaged three experts, comprising seasoned academics in Refrigeration and Air Conditioning from TVET colleges, to offer critical evaluation and input. The purpose of this appointment was to assess the efficacy of the designed learning module in enhancing the teaching and learning (T&L) process for Malaysian Vocational Certificate (MVC) students in the discipline. The findings of a comprehensive examination of the feedback and perspectives of the three specialists concerning the module's functionality are encapsulated in Table 4.

**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

Table 5 displays the findings of the investigation of the appropriateness of the content inside the Refrigerant Handling for Air Conditioning Systems Learning Module. The study findings indicate that absolute unanimity (100%) was attained for nearly all analysed criteria, including clarity of aims, comprehensibility of information, systematic content structure, and precise language usage. Experts unanimously concurred that this module facilitates self-directed learning, engages student interest, reinforces foundational knowledge, and offers accessible exercise examples and content that can be tailored to students' need. For the clarity of diagrams (Item 5), the level of agreement was 80%, although 20% of experts offered negative input on the criterion. Consequently, most of these data affirm that the module's material is very suitable for use in the teaching and learning process.

**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

Table 6 presents the results of the analysis regarding the efficacy of the Refrigerant Handling Learning Module for Air Conditioning Systems. The study's findings indicate that absolute consensus (100%) was attained for all examined items, with experts unanimously agreeing that this module serves as an excellent reference material, effectively delivering pertinent information and fulfilling user requirements. Furthermore, respondents affirmed the legitimacy and dependability of the module material, while also recognising the efficacy of the activities in promoting active student engagement and enhancing knowledge acquisition. This substantial agreement demonstrates that the created module possesses considerable and practical functional value for implementation in related educational subjects.

**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

Table 7 presents the results of the analysis of the design elements of the Refrigerant Handling Learning Module for Air Conditioning Systems. According to the results, complete unanimity (100%) was attained for all assessed design criteria, encompassing appealing visual elements and the appropriateness of typography regarding type and size for content presentation. Moreover, experts unanimously concurred that the choice of colour palette and visual integration was highly suitable and aligned with the content of the generated module. The methodical and visually compelling design demonstrates that the module effectively captures interest and encourages users to utilise it as a major reference resource.

**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

## 5.0 DISCUSSION AND RECOMMENDATION

The lack of adequate teaching materials has been recognised as a primary factor obstructing student involvement in educational sessions. Unstructured and minimally engaging teaching materials often result in students losing concentration and diminishing their interest in the educational topic (Haleem et al., 2022). This study investigates the necessity for the creation of learning modules on Refrigerant Handling in Air Conditioning Systems, particularly for students in the Refrigeration and Air Conditioning sector within TVET colleges. Learning modules are characterised as instructional resources methodically organised to enhance self-directed learning and augment student comprehension (Al Mamun & Lawrie, 2023). The modules created in this study are founded on the Sidek and Jamaluddin Model, which comprises two primary phases: the module draft development phase and the module assessment and validation phase.

A quality module must satisfy dependability standards, enabling users to attain learning objectives and execute the designated activities proficiently. This study's module development method encompasses systematic steps: goal establishing, background analysis, needs assessment, objective formulation, content selection, strategy selection, and refinement of the module draft. The designed modules are matched with the Vocational College Standard curricular (KSKV) to ensure conformity with current curricular requirements. A systematic and structured module development strategy enhances the quality of teaching materials by pilot testing and ongoing refinement (Branch, 2020). A disparity between pedagogical approaches and student learning preferences might induce pain and impair student concentration during the educational process. Consequently, the educational modules in this research were constructed in accordance with the Felder-Silverman Learning Style Model (FSLSM), which classifies learning styles into four primary dimensions: perception, input, processing, and understanding. This method facilitates a more diversified and inclusive information presentation, hence enhancing student engagement (Felder & Brent, 2020). Active student participation in the learning process has been demonstrated to enhance comprehension and mastery of topics more profoundly (Freeman et al., 2014; reiterated in the context of contemporary active learning by Theobald et al., 2020).

In the development of this module, researchers focused on content design elements, such as text organization, graphic utilisation, and information presenting flow. Systematically developed and visually clear teaching aids can enhance the efficacy of material presentation and promote student comprehension (Mayer, 2021). Prior research indicates that visual elements, like diagrams, pictures, and animations, enhance students' retention and comprehension of intricate concepts (Castro-Alonso et al., 2021). The incorporation of multimedia components in educational modules, including text, images, QR codes, and vibrant colours, enhances student engagement and motivation. The effective utilisation of multimedia can engage several senses of students and enhance learning results in both cognitive and affective domains (Sailer & Homner, 2020). This method aligns with multimedia design concepts that highlight the significance of integrating visual and spoken components to enhance learning efficacy (Mayer, 2021).

This study evaluates the efficacy of learning modules. The assessment was conducted to verify that the produced modules are appropriate for SVM students in the domain of Refrigeration and Air Conditioning. Expert feedback was gathered using a questionnaire to evaluate the module's content, functionality, and design elements. Assessing the usability of educational materials is crucial to guarantee that they fulfil user requirements and efficiently facilitate the teaching and learning process (Nielsen, 2020). The study results indicated that all participants offered favourable evaluations of the produced module, particularly regarding its usability and usefulness. Data analysis utilising descriptive statistics (frequency and percentage) indicated a significant level of acceptability of this module. This outcome aligns with prior research indicating that multimedia-based learning materials and meticulously designed modules enhance learning efficacy and facilitate students in attaining educational objectives more effectively (Haleem et al., 2022).

This study's findings indicate that the creation of structured learning modules, grounded on relevant learning theories and enhanced by engaging multimedia components, can enhance the efficacy of the teaching and learning process. The designed modules serve as both instructional tools and adaptable reference materials that students can utilise based on their individual needs and learning speed. Consequently, the amalgamation of effective pedagogical strategies with high-quality module design is crucial for achieving learning goals in the TVET context.

## 6.0 CONCLUSION

The primary purpose of developing the Refrigerant Handling Learning Module for Air Conditioning Systems has been successfully accomplished, as evidenced by comprehensive analysis and study findings. The creation of this module significantly enhances the sustainability of the teaching and learning (T&L) process, hence acting as a definitive reference for students and teachers in Refrigeration and Air Conditioning. Through a meticulous design process—beginning with the establishment of research objectives and culminating in an exhaustive literature review—the researchers have adeptly incorporated pertinent and impactful content elements. The implementation of this module is anticipated to enhance learning effectiveness and contribute positively to the development of skilled and knowledgeable human capital in the industry.

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## Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper

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