SEMARAK ILMU PUBLISHING
202103268166(003316878-P)

Semarak International Journal of Innovation in Learning and Education

Journal homepage:
https://semarakilmu.my/index.php/sijile/index
ISSN: 3030-5268

Effectiveness of the I-DECOBEST Module in Teaching Electrical Concepts in Primary Schools: Pilot Evidence from Penang

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ARTICLE INFO

Article history:
Received 17 November 2024
Received in revised form 6 December 2024
Accepted 15 December 2024
Available online 31 December 2024

Keywords:
Interdisciplinary learning; sustainability education; science process skills

ABSTRACT

The rapid evolution of educational practices necessitates innovative approaches to enhance science learning, particularly in abstract topics like electricity. This study evaluates the I-DECOBEST module, an interdisciplinary tool integrating design thinking, Cognitive Behaviour Therapy (CBT), and sustainable energy practices aimed at improving student engagement, emotional resilience, and practical understanding of sustainability within the Malaysian Kurikulum Standard Sekolah Rendah (KSSR). Involving 80 Year 5 students from a primary school in Penang, the study used a structured questionnaire to assess the module's clarity, engagement, and effectiveness. Descriptive statistics and reliability analysis (Cronbach's alpha = 0.887) confirmed high internal consistency and generally positive student perceptions. However, response variability highlights areas for improvement, particularly in practical applications and real-world integration. The findings demonstrate the module's potential to enhance scientific literacy and sustainability awareness while addressing gaps in traditional teaching methods. By aligning with global educational goals, the I-DECOBEST module offers a transformative framework for improving science education. Further research is recommended to validate its broader applicability.

1. Introduction

The rapid evolution of education has necessitated the development of novel and efficient teaching methodologies, especially in science education. As such, science forms the foundation of contemporary learning, equipping pupils with crucial knowledge and abilities to tackle future obstacles. In the Malaysian educational context, the Kurikulum Standard Sekolah Rendah (KSSR) emphasises cultivating scientific literacy, analytical thinking, and problem-solving capabilities in young students.

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https://doi.org/10.37934/sijile.5.1.4357 a

Nevertheless, educators face considerable hurdles when teaching abstract and intricate subjects, such as electricity. Conventional teaching approaches, which often prioritise memorisation and theoretical explanations, struggle to fully captivate students or facilitate a comprehensive grasp of scientific principles [1].

The I-DECOBEST module was created to tackle these issues, serving as a groundbreaking educational tool that combines design thinking, Cognitive Behaviour Therapy (CBT), and sustainable energy practices. This innovative approach aims to revolutionise the teaching and learning of electricity, making it more interactive, captivating, and relevant. Notably, design thinking promotes creative problem-solving, effective teamwork, and active student engagement in the learning process [2]. The overall conclusions are summarised in Figure 1, as illustrated:

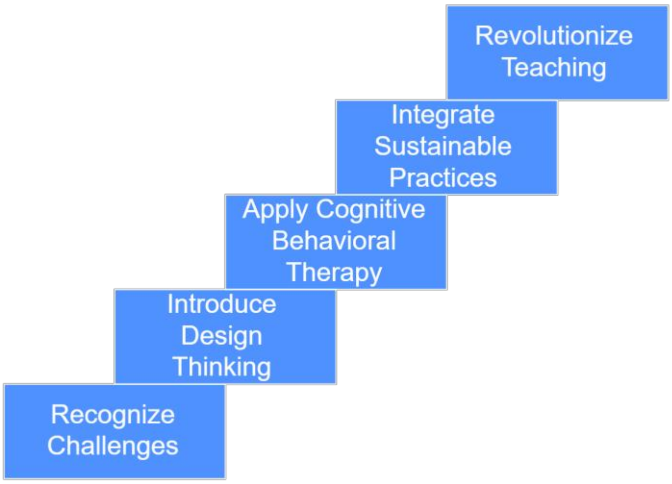


Fig. 1. Enhancing science education with I-DECOBEST

Concurrently, CBT emphasises enhancing students' emotional control and cognitive involvement, which are crucial for maintaining focus and building resilience when faced with educational challenges [3,4]. The incorporation of sustainable energy practices further enriches the module by deepening students' comprehension of environmental responsibility and energy literacy, providing them with practical knowledge to tackle real-world sustainability issues [5,6].

1.1 Problem Statement

The practical implementation and efficacy of educational innovation are often subject to scrutiny. In Malaysia, there is an urgent need to assess the dependability and feasibility of novel teaching modules in actual classroom environments. While the I-DECOBEST module shows promise as an intervention, its efficacy hinges on empirical data demonstrating its reliability as a teaching tool and its practical capacity to enhance pupils' educational experiences.

Despite the critical emphasis on science education within the Malaysian KSSR framework, existing teaching methodologies fail to emphasize the practical application of scientific concepts, particularly in fostering sustainability and energy literacy. For instance, while the curriculum highlights theoretical knowledge of renewable energy sources and environmental preservation, it often neglects experiential learning that allows students to apply these principles in real-world contexts [7]. Current approaches are predominantly lecture-based, focusing on rote memorization rather than engaging students in problem-solving activities that mimic real-world challenges, such as designing renewable energy solutions or conducting environmental impact assessments [8,9].

Students frequently perceive the topic of electricity as challenging. The intangible nature of concepts such as circuits, current, and energy transfer often results in misconceptions and disinterest. Additionally, current teaching methods offer limited opportunities for students to apply their knowledge to real-world scenarios. This dearth of hands-on learning impedes the development of crucial Science Process Skills (SPS), vital for scientific inquiry and problem-solving [9]. Moreover, fostering energy literacy is a pressing concern in global sustainability. Learners must be equipped with the necessary knowledge and abilities to comprehend energy systems, make well-informed decisions regarding energy consumption, and embrace sustainable practices [10].

Moreover, fostering energy literacy is a pressing concern in global sustainability. Learners must be equipped with the necessary knowledge and abilities to comprehend energy systems, make well-informed decisions regarding energy consumption, and embrace sustainable practices [11]. However, existing educational approaches often fail to effectively incorporate sustainability concepts into the science curriculum. This shortfall necessitates the creation of modules such as I-DECOBEST, which amalgamate energy literacy with science education and nurture knowledge and practical skills. For example, integrating energy literacy into science education has been shown to enhance students' understanding of sustainability and promote informed decision-making [12]. Similarly, innovative approaches such as collaborative educational projects and experiential learning frameworks have demonstrated the potential to foster energy literacy effectively [13,14].

An additional crucial factor is students' disposition towards science learning. Attitudes strongly predicted engagement, perseverance, and achievement in science. Nevertheless, many students perceive science as challenging and daunting, potentially discouraging their active participation in learning activities. This underscores the need for innovative teaching methodologies that augment knowledge and improve students' attitudes toward science. Research indicates that science attitudes significantly influence teaching efficacy and learning outcomes, with positive attitudes correlating with enhanced engagement and persistence [15]. Furthermore, inquiry-based and constructivist methodologies have been shown to foster better attitudes and critical thinking skills in science education [16]. Moreover, evaluating all aspects as the foundation for testing the I-DECOBEST module aims to verify that the module's structural integrity can address the issues outlined in Figure 2.

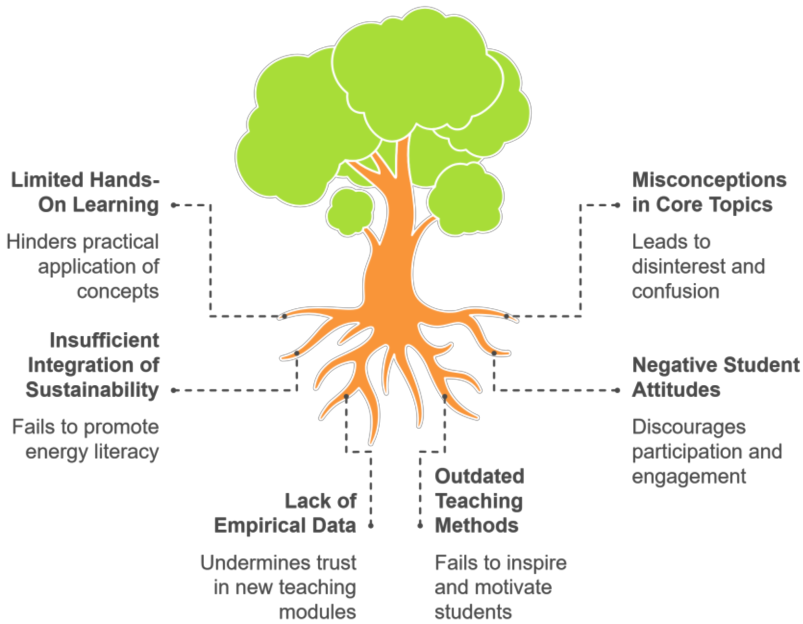


Fig. 2. Ineffective science education and student engagement

This comprehensive assessment ensures that the module's design and implementation effectively tackle the identified problems.

1.2 Justification for the Research

This deficiency necessitates innovative approaches like the I-DECOBEST module, which integrates interdisciplinary learning with practical problem-solving exercises. Such modules have been shown to improve learning outcomes, encourage environmental stewardship, and increase student engagement [17]. Research highlights that active learning strategies, including project-based tasks and real-world simulations, significantly enhance students' understanding of sustainability while fostering critical thinking and collaboration skills [18].

By addressing these shortcomings, this study aims to fill a critical void in science education, particularly in advancing sustainability and energy literacy. It aligns with global education trends and Malaysia's sustainable development goals, equipping students with the skills and knowledge to address environmental challenges effectively. The integration of design thinking, cognitive-behavioral therapy (CBT), and sustainable energy practices in the I-DECOBEST module underscores the need for research-backed educational innovations tailored to modern challenges.

The relevance and urgency of this study stem from its evaluation of the reliability and feasibility of the I-DECOBEST module in addressing critical educational challenges. Reliability, a crucial aspect of any teaching tool, ensures consistent outcomes and predictable performance. By investigating the module's reliability, this research provides empirical evidence on whether the I-DECOBEST module consistently supports students in achieving their intended learning goals [19].

Consequently, to ensure that I-DECOBEST modules are reliable and practical, Figure 3 illustrates the necessity of determining their applicability within pilot studies as follows:

Fig. 3. Ineffective science education and student engagement

The I-DECOBEST module's emphasis on interdisciplinary integration aligns with the current research, highlighting the advantages of such approaches in primary education. For instance, Kubisch *et al*., [20] explored how transdisciplinary education empowers students toward sustainable development by integrating collaborations across community and educational settings. Similarly, Delplancke *et al*., [21] emphasized the role of interdisciplinary methods in fostering collaboration and reflexivity to address socio-environmental challenges.

Additionally, Suanoo *et al*., [22] illustrated innovative teaching approaches combining design and education, aligning with sustainable development goals to enhance learning outcomes. These insights resonate with the integration of linguistic and cultural knowledge in cross-disciplinary language instruction [23]. Furthermore, Ji *et al*., [14] underlined how ecological culture and interdisciplinary teaching in primary science improve ecological awareness and sustainability comprehension.

On the other hand, Vasquez *et al*., [24] illustrated how combining science, technology, and environmental education in primary schools enhances students' socio-environmental understanding. This integration aligns with global educational priorities, including the United Nations' Sustainable Development Goals (SDGs) [25].

Furthermore, this pilot study lays the groundwork for future research. The findings will inform further improvements to the module and ensure its effectiveness and adaptability in diverse educational settings. Additionally, by focusing on the module's applicability, this research provides practical insights for educators and policymakers, demonstrating how innovative teaching tools can be seamlessly integrated into existing curricula to enhance student outcomes.

1.3 Objectives of the Study

The eight-week evaluation period in this study aligns with the primary objectives of a pilot study, which are to assess feasibility, immediate outcomes, and implementation challenges, rather than long-term impacts. Morozumi *et al*., [26] emphasized that pilot studies are designed to establish methodological validity and gather initial data, serving as a precursor to more extensive longitudinal research. Additionally, Muresherwa *et al*., [27] underscore the importance of phased research, where short-term evaluations in pilot studies provide critical insights that inform the design of comprehensive, long-term investigations. A recent pilot implementation in education demonstrates how preliminary assessments can lead to improvements in larger-scale studies, addressing both immediate challenges and long-term goals [28].

While the current study focuses on immediate educational outcomes, plans for subsequent longitudinal studies are already envisioned to examine the durability of knowledge retention and skill development facilitated by the I-DECOBEST module. The primary aim of this pilot study was to evaluate the effectiveness of the I-DECOBEST module in teaching electricity within the KSSR framework.The specific objectives of this study were as follows:

1. To assess the reliability of the I-DECOBEST module as an instructional tool.
2. To evaluate the applicability of the I-DECOBEST module in real classroom settings.
3. To gather feedback on students' experiences and perceptions of the module.
4. To provide recommendations for refining and improving the module for broader implementation.

Therefore, it is hoped that with the objective focus that has been planned, the following sections of this paper will elaborate on the methodology, findings, and discussions.

2. Methodology

This section discusses the use of methodology to obtain respondent information, the use of instruments, and the use of quantitatively related analytical tools.

2.1 Research Design

This study adopted a quantitative research design to evaluate the reliability and applicability of the I-DECOBEST module. A structured questionnaire was administered to collect data on students' perceptions of the module, focusing on its clarity, engagement, and effectiveness. These pilot studies play a pivotal role in educational research, serving as a methodological cornerstone for testing feasibility, refining research tools, and addressing practical challenges before broader implementation. As highlighted by Naidoo *et al*., [15], they provide critical insights into the development and application of teaching strategies, ensuring that interventions are both effective and contextually relevant. Similarly, Sundram *et al*., [28] emphasizes their importance in establishing methodological rigor and ensuring clarity between feasibility and pilot studies, which enhances the credibility of subsequent large-scale research.

Muresherwa *et al*., [27] further underscore the utility of pilot studies in determining the most suitable research methodologies and tools, facilitating an optimal theory-method alignment. In addition, Sundram *et al*., [28] demonstrates their capacity to validate innovative pedagogical approaches, showcasing their impact on enhancing student engagement and educational outcomes. Although the sample size in this study is intentionally limited, this aligns with the objectives of pilot research—to generate foundational evidence, validate the I-DECOBEST module, and inform the design of larger, more generalizable studies. This approach ensures methodological soundness and provides a robust foundation for scaling the intervention across diverse educational contexts.

2.2 Participants

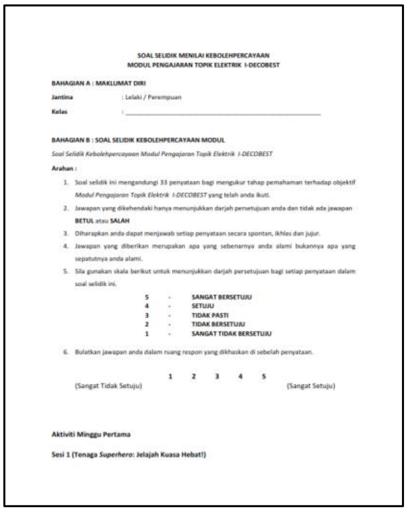
The study involved 80 Year 5 students from a primary school in Penang. Participants were selected using purposive sampling to ensure they had prior electricity exposure within the KSSR curriculum. The sample included a balanced representation of gender and class to ensure the generalisability of the findings.

2.3 Instruments

The use of self-reported data in this pilot study is methodologically appropriate given its exploratory nature, serving as an essential step in evaluating the feasibility and preliminary effectiveness of the I-DECOBEST module. Jones *et al*., [29] emphasized that validated self-reported instruments are critical in early-stage research, offering reliable measures for exploratory analysis. Furthermore, [30] highlighted the role of self-assessments in validating educational tools, ensuring reliability and construct validity for broader application. Similarly, Sundram *et al*., [28] underscored the importance of pilot studies in testing and refining self-reported instruments to establish their methodological rigor.

While self-reported data have inherent limitations, Radović, *et al*., [31] demonstrated their utility in capturing early indicators of engagement and learning behaviors, making them particularly valuable in pilot research. Future research phases, as suggested by Francisca [32], should incorporate triangulated methodologies, including observational and performance-based metrics, to address potential biases and enhance the robustness of findings. This iterative approach ensures that the foundational research remains rigorous and methodologically sound, paving the way for scaling the module to diverse educational contexts.

The primary data collection instrument was a structured questionnaire comprising 34 items. Each item corresponds to the specific learning objectives of the I-DECOBEST module, which assesses student experiences and satisfaction with the module. Note that the questionnaire used a 5-point Likert scale ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"). This scale enables the collection of nuanced feedback on various aspects of the module, including content clarity, engagement, and perceived learning outcomes. An example of a questionnaire is displayed in Figure 4.



SOAL SELIDIK MENILAI KEBOLEHPERCAYAAN
MODUL PENGAJARAN TOPIK ELEKTRIK I-DECOBEST

BAHAGIAN A : MAKLUMAT DIRI

Jantina : Lelaki / Perempuan

Kelas : ____________________

BAHAGIAN B : SOAL SELIDIK KEBOLEHPERCAYAAN MODUL

Soal Selidik Kebolehpercayaan Modul Pengajaran Topik Elektrik I-DECOBEST

Arahan :

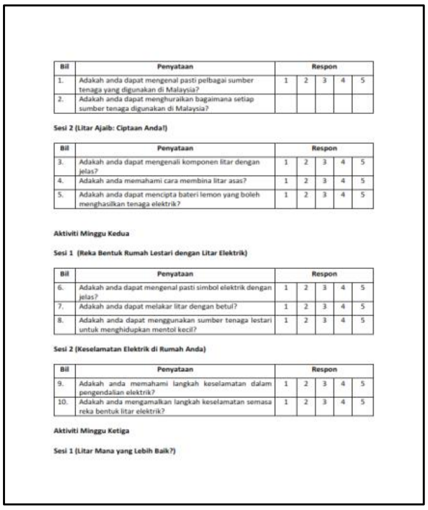
1. Soal selidik ini mengandungi 33 penyataan bagi mengukur tahap pemahaman terhadap objektif *Modul Pengajaran Topik Elektrik I-DECOBEST* yang telah anda ikuti.
2. Jawapan yang dikehendaki hanya menunjukkan darjah persetujuan anda dan tidak ada jawapan **BETUL** atau **SALAH**
3. Diharapkan anda dapat menjawab setiap penyataan secara spontan, ikhlas dan jujur.
4. Jawapan yang diberikan merupakan apa yang sebenarnya anda alami bukannya apa yang sepatutnya anda alami.
5. Sila gunakan skala berikut untuk menunjukkan darjah persetujuan bagi setiap penyataan dalam soal selidik ini.

   5 - SANGAT BERSETUJU
   4 - SETUJU
   3 - TIDAK PASTI
   2 - TIDAK BERSETUJU
   1 - SANGAT TIDAK BERSETUJU
6. Bulatkan jawapan anda dalam ruang respon yang dikhaskan di sebelah penyataan.

1 2 3 4 5
(Sangat Tidak Setuju) (Sangat Setuju)

Aktiviti Minggu Pertama

Sesi 1 (Tenaga *Superhero*: Jelajah Kuasa Hebat!)



Bil	Penyataan	Respon				
1.	Adakah anda dapat mengenal pasti pelbagai sumber tenaga yang digunakan di Malaysia?	1	2	3	4	5
2.	Adakah anda dapat menghuraikan bagaimana setiap sumber tenaga digunakan di Malaysia?					

Sesi 2 (Litar Ajaib: Ciptaan Anda!)

Bil	Penyataan	Respon				
3.	Adakah anda dapat mengenali komponen litar dengan jelas?	1	2	3	4	5
4.	Adakah anda memahami cara membina litar asas?	1	2	3	4	5
5.	Adakah anda dapat mencipta bateri lemon yang boleh menghasilkan tenaga elektrik?	1	2	3	4	5

Aktiviti Minggu Kedua

Sesi 1 (Reka Bentuk Rumah Lestari dengan Litar Elektrik)

Bil	Penyataan	Respon				
6.	Adakah anda dapat mengenal pasti simbol elektrik dengan jelas?	1	2	3	4	5
7.	Adakah anda dapat melakar litar dengan betul?	1	2	3	4	5
8.	Adakah anda dapat menggunakan sumber tenaga lestari untuk menghidupkan mentol kecil?	1	2	3	4	5

Sesi 2 (Keselamatan Elektrik di Rumah Anda)

Bil	Penyataan	Respon				
9.	Adakah anda memahami langkah keselamatan dalam pengendalian elektrik?	1	2	3	4	5
10.	Adakah anda mengamalkan langkah keselamatan semasa reka bentuk litar elektrik?	1	2	3	4	5

Aktiviti Minggu Ketiga

Sesi 1 (Litar Mana yang Lebih Baik?)

(a) (b)

Fig. 4. (a) Student Information (b) List of Items to be answered by students

This instrument lists 34 questions adapted from the content objectives of the I-DECOBEST module, which includes eight weeks of intervention. Table 1 summarises a list of questions for students to answer after each intervention.

Table 1
Reliability questionnaire for the I-DECOBEST module

No.	Actual Question (Malay)	Question (English Translation)
1	Adakah anda dapat mengenal pasti pelbagai sumber tenaga yang digunakan di Malaysia?	Can you identify various energy sources used in Malaysia?
2	Adakah anda dapat menghuraikan bagaimana setiap sumber tenaga digunakan di Malaysia?	Can you explain how each energy source is utilised in Malaysia?
3	Adakah anda dapat mengenali komponen litar dengan jelas?	Can you clearly recognise circuit components?
4	Adakah anda memahami cara membina litar asas?	Do you understand how to build a basic circuit?
5	Adakah anda dapat mencipta bateri lemon yang boleh menghasilkan tenaga elektrik?	Can you create a lemon battery that generates electrical energy?
6	Adakah anda dapat mengenal pasti simbol elektrik dengan jelas?	Can you clearly identify electrical symbols?
7	Adakah anda dapat melakar litar dengan betul?	Can you draw circuits correctly?
8	Adakah anda dapat menggunakan sumber tenaga lestari untuk menghidupkan mentol kecil?	Can you use sustainable energy sources to power a small bulb?
9	Adakah anda memahami langkah keselamatan dalam pengendalian elektrik?	Do you understand safety measures in handling electricity?
10	Adakah anda mengamalkan langkah keselamatan semasa reka bentuk litar elektrik?	Do you practice safety measures while designing electrical circuits?
11	Adakah anda dapat membina litar bersiri dan litar selari?	Can you build series and parallel circuits?
12	Adakah anda dapat membandingkan litar bersiri dan litar selari berdasarkan fungsi komponen?	Can you compare series and parallel circuits based on component functions?
13	Adakah anda dapat mengenal pasti cara-cara menjimatkan tenaga di sekolah?	Can you identify ways to save energy in school?
14	Adakah anda dapat melaksanakan eksperimen untuk mengurangkan penggunaan tenaga?	Can you conduct experiments to reduce energy consumption?
15	Bolehkah anda mereka bentuk litar elektrik yang berfungsi dengan bahan terpakai?	Can you design a functioning electrical circuit using recycled materials?
16	Bolehkah anda menguji litar elektrik untuk kegunaan pusat komuniti?	Can you test electrical circuits for community centre use?

No.	Actual Question (Malay)	Question (English Translation)
17	Bolehkah anda menguji litar yang telah dibina untuk memastikan ia selamat?	Can you test built circuits to ensure they are safe?
18	Bolehkah anda menguji litar untuk memastikan ia berfungsi dengan baik?	Can you test circuits to ensure proper functioning?
19	Bolehkah anda mengaitkan konsep elektrik dengan kehidupan seharian anda?	Can you relate electrical concepts to your daily life?
20	Bolehkah anda memahami projek berkaitan elektrik dalam kehidupan seharian?	Can you understand electricity-related projects in daily life?
21	Bolehkah anda menambah ciri-ciri tambahan kepada litar yang anda bina?	Can you add additional features to the circuits you build?
22	Bolehkah ciri-ciri tambahan ini digunakan untuk kegunaan pusat komuniti?	Can these additional features be used in community centres?
23	Bolehkah anda merancang kempen kesedaran tenaga di sekolah?	Can you plan an energy awareness campaign at school?
24	Bolehkah anda merancang kempen kesedaran tenaga untuk pusat komuniti?	Can you plan an energy awareness campaign for the community centre?
25	Bolehkah anda merefleksi pengalaman anda semasa belajar tentang elektrik?	Can you reflect on your experiences while learning about electricity?
26	Adakah anda membentuk sikap yang lebih positif terhadap pembelajaran elektrik?	Have you developed a more positive attitude toward learning electricity?
27	Bolehkah anda memperbaiki litar elektrik dalam model bangunan?	Can you improve electrical circuits in building models?
28	Bolehkah anda menaik taraf litar elektrik menggunakan tenaga boleh baharu atau tidak boleh baharu?	Can you upgrade electrical circuits using renewable or non-renewable energy?
29	Bolehkah anda membentangkan projek model bangunan anda dengan yakin kepada rakan sekelas?	Can you confidently present your building model project to classmates?
30	Bolehkah anda membentangkan projek model bangunan anda dengan yakin kepada guru?	Can you confidently present your building model project to the teacher?
31	Bolehkah anda mempersembahkan projek anda dengan jelas kepada rakan sekelas, guru, dan komuniti?	Can you clearly present your project to classmates, teachers, and the community?
32	Bolehkah anda menerima maklum balas konstruktif untuk menambah baik projek anda?	Can you accept constructive feedback to improve your project?
33	Bolehkah anda mengenal pasti kekuatan dan kelemahan dalam pembelajaran anda?	Can you identify strengths and weaknesses in your learning?
34	Bolehkah anda menetapkan matlamat untuk penambahbaikan pada masa hadapan?	Can you set goals for future improvements?

The questionnaire (Table 1) for the I-DECOBEST module provides an overview of students' experiences and learning outcomes related to electricity. It consists of 34 questions covering key areas across multiple weeks of instruction. Early questions focused on foundational knowledge, such as identifying energy sources and understanding circuit components. Midway, the questions assessed skills in building and testing circuits as well as understanding energy conservation. Toward the end, the questions addressed the application of knowledge in practical settings, such as designing circuits for community projects, presenting findings, and reflecting on learning progress. This structured approach comprehensively evaluated the students' knowledge, skills, and attitudes developed through the module.

2.4 Procedure

The module was implemented over an eight-week period, during which students engaged in a series of interactive and practical activities designed to enhance their understanding of electricity. At the conclusion of the intervention, the students completed a questionnaire and provided feedback on their experiences with the module.

2.5 Data Analysis

Data from the questionnaires were analysed using SPSS version 27. The analysis included:

1. Descriptive Statistics: To summarise the central tendencies and variability of students' responses.
2. Reliability Analysis: Cronbach's alpha was computed to assess the internal consistency of the questionnaire, ensuring the reliability of the instrument.
3. Inferential Statistics: Shapiro-Wilk tests were conducted to check the normality of the data distribution. Based on these results, further statistical analyses were performed to explore the applicability of the module and the areas of improvement.

This comprehensive methodological approach ensured a robust evaluation of the I-DECOBEST module, providing valuable insights for its refinement and wider adoption in Malaysian primary schools.

3. Results

When conducting this study, the Results and Discussion section focused on the findings through analysis using Statistical Package for Social Science (SPSS) version 27 to collect data on the reliability of the I-DECOBEST module, which was fed back to 80 year-five students in one of the schools in Penang. The discussion findings will be reviewed using descriptive statistics and data normality tests, followed by the results and discussion on reliability.

3.1 Descriptive Statistics

Descriptive statistics for the I-DECOBEST module items (S1–S34) are presented in Table 1. Mean scores ranged from 3.11 (S_31) to 3.63 (S_15), indicating generally positive perceptions of the module's effectiveness in teaching electricity concepts. The standard deviations ranged from 1.238 to 1.519, reflecting moderate response variability. This variability suggests that while most students responded favourably, differences in individual perceptions were evident.

Table 2
Descriptive statistics and normality tests for items S1–S34

Item	Mean	Std. Dev.	Skewness	Kurtosis	Shapiro-Wilk W	Sig. (p)
S_1	3.38	1.504	-0.280	-1.411	0.843	< 0.001
S_2	3.38	1.391	-0.242	-1.230	0.873	< 0.001
S_3	3.40	1.269	-0.227	-1.026	0.893	< 0.001
S_4	3.24	1.380	-0.352	-1.072	0.881	< 0.001
S_5	3.45	1.359	-0.467	-0.953	0.873	< 0.001
S_6	3.48	1.321	-0.232	-1.257	0.867	< 0.001
S_7	3.29	1.255	-0.133	-0.958	0.892	< 0.001
S_8	3.34	1.466	-0.338	-1.225	0.860	< 0.001
S_9	3.20	1.453	-0.232	-1.299	0.874	< 0.001
S_10	3.44	1.320	-0.386	-0.997	0.884	< 0.001
S_11	3.31	1.393	-0.178	-1.298	0.876	< 0.001
S_12	3.39	1.480	-0.436	-1.226	0.849	< 0.001
S_13	3.50	1.350	-0.538	-0.935	0.864	< 0.001
S_14	3.43	1.310	-0.248	-1.162	0.862	< 0.001
S_15	3.63	1.296	-0.622	-0.710	0.861	< 0.001
S_16	3.34	1.302	-0.269	-1.044	0.896	< 0.001
S_17	3.35	1.476	-0.267	-1.350	0.886	< 0.001
S_18	3.28	1.368	-0.211	-1.200	0.886	< 0.001
S_19	3.44	1.339	-0.333	-1.066	0.879	< 0.001
S_20	3.29	1.352	-0.260	-1.140	0.890	< 0.001
S_21	3.28	1.387	-0.248	-1.210	0.890	< 0.001
S_22	3.29	1.451	-0.265	-1.363	0.863	< 0.001
S_23	3.28	1.321	-0.188	-1.085	0.897	< 0.001
S_24	3.35	1.388	-0.424	-1.075	0.864	< 0.001
S_25	3.25	1.463	-0.349	-1.248	0.863	< 0.001
S_26	3.46	1.517	-0.518	-1.191	0.828	< 0.001
S_27	3.19	1.519	-0.171	-1.451	0.858	< 0.001
S_28	3.50	1.283	-0.683	-0.495	0.801	< 0.001
S_29	3.40	1.365	-0.336	-1.127	0.879	< 0.001
S_30	3.24	1.324	-0.250	-1.116	0.895	< 0.001
S_31	3.11	1.331	-0.079	-1.061	0.874	< 0.001
S_32	3.16	1.462	-0.090	-1.353	0.874	< 0.001
S_33	3.39	1.238	-0.208	-0.898	0.896	< 0.001
S_34	3.36	1.305	-0.357	-0.940	0.896	< 0.001

The Shapiro-Wilk test revealed significant deviations from normality for all items ($p < 0.001$). This finding aligns with the common occurrence of non-normal distributions in Likert-scale data, which are ordinal in nature [13]. Despite these deviations, parametric tests remain robust and appropriate for educational research, particularly with moderate sample sizes [14].

3.2 Reliability Analysis

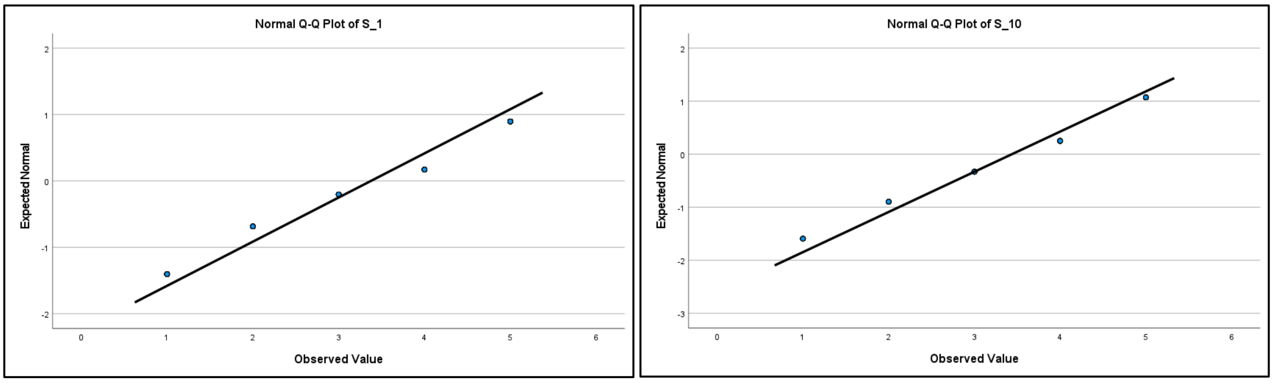
The reliability of the I-DECOBEST module was assessed using Cronbach's alpha, which yielded a value of 0.887 (as summarised in Table 3). This indicated high internal consistency, confirming that the items consistently measured the students' perceptions of the module's effectiveness. Notably, such reliability is crucial for ensuring the instrument provides dependable results [15].

Table 3
Reliability statistics result

Cronbach's alpha	N of Items
0.887	34

3.2.1 Q-Q plots

Q-Q plots for selected items (for example, S1–S10) were used to visually assess the normality of the data. Minor deviations from the expected normal distribution line were observed, consistent with the Shapiro-Wilk results. Note that these deviations are typical for ordinal data collected via Likert scales and do not compromise the reliability of parametric analyses [16-20]. The Q-Q example illustrated in Figure 2 for items S1 and S10 demonstrates a normal distribution:



(a) (b)

Figure 5. (a) Q-Q Plot for S1 and (b) Q-Q Plot for S10

Descriptive statistics indicated that students generally viewed the I-DECOBEST module positively, with all items scoring above the midpoint. While most students reported the module effective, the variability in responses highlighted potential areas for improvement, particularly for items with lower mean scores, such as S_31. Despite deviations from normality, the module's high reliability (α = 0.887) demonstrated its robustness as a tool for measuring student engagement and learning outcomes.

4. Discussion

The use of self-reported data in this pilot study is methodologically sound, aligning with the exploratory objectives of assessing the feasibility and preliminary effectiveness of the I-DECOBEST module. Recent studies underscore the value of validated self-reported instruments in educational research. For instance, Iacono *et al.*, [33] demonstrated strong reliability in educational assessment tools, emphasizing the importance of methodological rigor in pilot studies. Similarly, [34] validated tools for measuring educational quality and student satisfaction, illustrating the robustness of self-reported measures in capturing meaningful insights.

The reliance on self-reported data is particularly justified in exploratory contexts, where instruments are often refined for subsequent applications. Sanjari *et al.*, [35] validated the "Engagement in E-Learning Scale" with a Cronbach's alpha of 0.95, showcasing the potential of self-reported data to provide reliable insights into student engagement. Furthermore, Pit *et al.*, [36] highlighted the importance of exploratory factor analysis in refining survey tools, ensuring their suitability for diverse educational contexts.

Despite inherent limitations, self-reported data effectively capture early indicators of learning outcomes and student engagement. Putri *et al.*, [37] showed that well-constructed self-report measures meet validity standards, while Putri *et al.*, [37] affirmed the reliability of tools used in educational assessments with high correlation coefficients. These findings reinforce the utility of self-reported data as a foundational step in refining educational interventions.

Future phases of this research should address potential biases inherent in self-reported data by incorporating complementary methodologies such as observational analyses and performance-based assessments. Triangulated approaches will enhance the robustness of findings and ensure that the module's effectiveness is comprehensively evaluated. This iterative methodology aligns with best practices in educational research and enables the refinement of instruments for broader application, as evidenced by Raof *et al.*, [38].

In conclusion, this pilot study successfully demonstrates the methodological appropriateness of self-reported data in capturing initial insights into the I-DECOBEST module's impact. Building on these findings, the iterative inclusion of additional methodologies will ensure the scalability and adaptability of the module to diverse educational settings, fostering rigorous and impactful educational research.

5. Conclusions

This study aimed to evaluate the I-DECOBEST module across multiple dimensions, with a focus on its reliability, applicability, and student reception. The findings provide valuable insights that address each of the research objectives and offer a pathway for future refinement and implementation.

- Reliability of the I-DECOBEST Module

The module demonstrated high internal consistency, as evidenced by a Cronbach's alpha of 0.887. This robust reliability affirms that the module effectively measures its intended objectives, particularly in enhancing students' understanding of electricity concepts. This strong reliability validates its use as an instructional tool, ensuring dependable results across diverse student populations.

- Applicability in Real Classroom Settings

Descriptive statistics revealed generally positive student perceptions of the module, with all items scoring above the midpoint on the Likert scale. Despite minor deviations from data normality, the module was shown to be well-suited for real classroom environments, engaging students effectively while addressing key learning objectives. Variability in responses, however, highlights areas requiring adjustment to optimize its applicability across different classroom contexts.

- Students' Experiences and Perceptions

Feedback from students indicated an overall favorable reception of the module, with most items scoring above 3.11 on a 5-point scale. Students appreciated its interactive and comprehensive approach to teaching electricity, although certain areas (e.g., items with lower mean scores like S_31) warrant further attention to enhance user satisfaction. This feedback underscores the module's potential to foster active learning and improve students' conceptual understanding.

- Recommendations for Refinement and Broader Implementation

To ensure the module's effectiveness on a broader scale, targeted improvements are necessary. Refining specific elements that received lower scores will enhance its utility and inclusiveness. Additionally, integrating adaptive elements to cater to varied learning needs will make the module more versatile. Providing teachers with training on module usage will further support its implementation and maximize its impact.

- Future Research and Enhancements

Future studies should adopt a longitudinal approach to examine the module's long-term effects on knowledge retention, skill development, and learning outcomes. Incorporating triangulated methodologies, such as observational studies and performance-based assessments, will enrich the evaluation process and mitigate the limitations of self-reported data. Expanding the scope to include diverse educational settings and student demographics will further validate the module's scalability and adaptability.

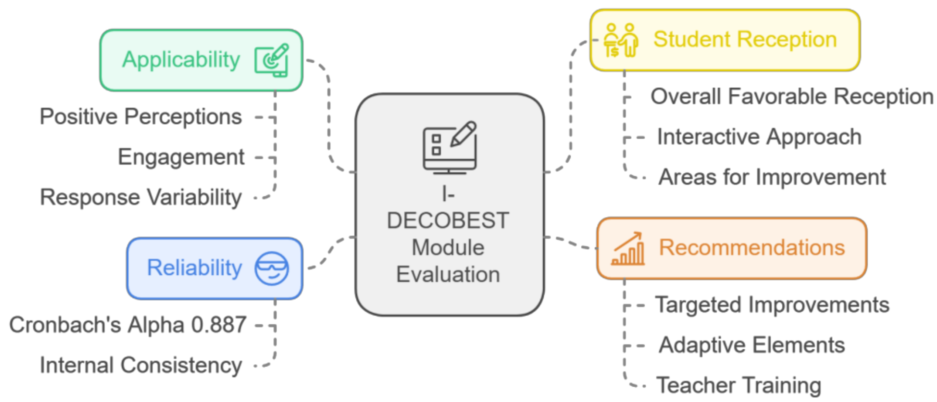


Figure 6. Refinement for Future Research Incorporating I-DECOBEST Module

Finally, collaboration with educators and policymakers will be crucial for refining the module and aligning it with national educational goals and international benchmarks like the United Nations' Sustainable Development Goals (SDGs). Iterative testing and refinement based on these recommendations will ensure that the I-DECOBEST module evolves as a robust, impactful tool for modern science education.This holistic approach will position the I-DECOBEST module as a model for innovative instructional design, bridging theoretical concepts with practical applications and equipping students with the skills needed for real-world challenges.

Acknowledgment

No funding was provided for this study. The researchers extend their gratitude to the School of Educational Studies at Universiti Sains Malaysia. Ethical clearance for this investigation was granted by USM (USM/JEPeM/PP/24050398).

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