# Effectiveness of the THINK Module in Teaching and Learning Health Education Based on the STEM Approach for Primary School Students

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## ABSTRACT

This study aims to develop a project-based learning module integrated with the concepts of Science, Technology, Engineering, and Mathematics (THINK Module) for the Year 5 Health Education subject using a modified Design and Development Research (DDR) approach. The developed THINK Module achieved a high approval percentage of 90% for validity and demonstrated high reliability, with a Cronbach's Alpha reliability index of 0.935. The effectiveness of the THINK Module in enhancing Higher-Order Thinking Skills (HOTS) and 21st-century skills was evaluated in the assessment phase using a pre-experimental one-shot case study involving three types of daily primary schools in the Seberang Perai Tengah district, Penang. The schools were randomly selected, and the study sample comprised three teachers and 93 students. A ten-week intervention program based on the THINK Module was implemented to assess its impact using the HOTS test and the M-21CSI questionnaire. The overall mean score for the HOTS test was recorded at M = 70.60, indicating a good level of HOTS mastery among students across all three schools. Meanwhile, the overall mean score for the M-21CSI questionnaire was M = 4.19, signifying a high level of 21st-century skill mastery. The results of the ANOVA test for HOTS mastery levels across the three schools indicated no significant differences at $p > 0.05$, $F(2,90) = .181$, $p = .835$. Similarly, data analysis for 21st-century skill mastery levels across the three schools showed no significant differences at $p > 0.05$, $F(2,90) = .725$, $p = .487$. The Pearson correlation coefficient, r, for the relationship between HOTS and 21st-century skills was .024 ($r = .024$), suggesting that the two variables did not exhibit a positive relationship and were not correlated. In conclusion, the implementation of the THINK Module in teaching and learning processes significantly enhances students' HOTS and 21st-century skills.

**Keywords:** Teaching Module, STEM, Health Education, Higher-Order Thinking Skills, 21st Century Learning.

## INTRODUCTION

The National Curriculum aims to cultivate a balanced generation for Malaysia's future, equipped with 21st Century Skills. Students who acquire these skills—encompassing critical, creative, and innovative thinking—are better prepared to compete globally. These competencies align with the six student aspirations outlined in the Malaysia Education Development Plan (PPPM). Consequently, the Ministry of Education Malaysia (KPM) has prioritized critical thinking as a key component of 21st Century Skills to prepare the younger generation for future challenges, particularly in STEM. According to [12], the STEM field plays a crucial role in fostering 21st Century Skills and HOTS among students, establishing a clear connection between these skills and STEM education.

One of the key initiatives in the Malaysia Education Blueprint (PPPM) is the enhancement of STEM education quality and the promotion of Higher-Order Thinking Skills in 21st century learning [12]. Based on the analysis of student performance in the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), the Ministry of Education emphasizes the importance of aligning Malaysia's education system with global standards to ensure the effective implementation of HOTS across all subjects [2]. The introduction of STEM education supports the PPPM

agenda by encouraging inquiry-based learning approaches, where students actively engage in exploring and constructing knowledge.

Health Education is a component of the Physical and Health Education (PJPK) subject within the core curriculum at the primary school level. The Curriculum and Assessment Standard Document for PJPK integrates the six pillars of the Standard Primary School Curriculum (KSSR) framework, combining knowledge, skills, and values while embedding 21st Century Skills and Higher-Order Thinking Skills. Science and technology are key elements within the KSSR, emphasizing the mastery of STEM concepts. One of the primary goals of the PJPK KSSR is to enhance students' understanding of PJPK concepts through meaningful learning experiences and skill development, with a particular focus on 21st Century Skills and HOTS [1]. The subject aims to produce students who are knowledgeable, skilled, and value-oriented, with positive attitudes toward maintaining physical fitness and health [10]. In response to these educational objectives, the researcher developed a STEM-based teaching module called the THINK Module to investigate its impact on students' achievement and the enhancement of Higher-Order Thinking Skills. The study focuses on three types of primary schools: Malay-medium schools (SK), Chinese-medium schools (SJKC), and Tamil-medium schools (SJKT). The THINK Module will be translated into the respective medium of instruction for each school to ensure effective implementation and accessibility.

### Objectives of Study

This study will encompass seven objectives, structured into three phases:

#### Needs Analysis Phase

1. To identify the need for developing the THINK Module through the STEM approach for the Year 5 Health Education subject among Health Education teachers.
2. To determine the suitability of integrating STEM concepts into the learning topics of the Year 5 Health Education subject.

#### Design and Development Phase

1. To establish the validity of the THINK teaching module based on the STEM approach for the Year 5 Health Education subject.
2. To determine the reliability of the THINK teaching module based on the STEM approach for the Year 5 Health Education subject.

#### Effectiveness Evaluation Phase

1. To identify the level of mastery and achievement in higher-order thinking skills (HOTS) and 21st-century skills using the THINK Module for the Year 5 Health Education subject through the STEM approach, categorized by school type.
2. To compare the level of mastery and achievement in HOTS and 21st-century skills using the THINK Module for the Year 5 Health Education subject through the STEM approach, categorized by school type.
3. To examine the relationship between higher-order thinking skills and 21st-century skills.

## EXPERIMENTAL SECTION/ MATERIAL AND METHODS

This study adopts the Design and Development Research (DDR) approach, which is an adaptation of the Research and Development model [21]. The effectiveness of the module is evaluated based on its ability to enhance HOTS and 21st Century Skills. The DDR approach consists of three key phases: needs analysis, design and development, and usability evaluation. This methodology is consistent with the research conducted by [5], [20], where the design and development framework was applied as follows:

Needs Analysis Phase: During the needs analysis phase, the researcher adopted McKillip's (1987) Discrepancy Model to determine the development requirements for the STEM-based THINK Module [15]. The sample selection process began with the identification of four experts to establish the content validity of the

questionnaire, as recommended by [14]. Following this, a pilot study was conducted with 30 expert teachers, selected through purposive sampling, to assess the reliability of the needs analysis questionnaire. Subsequently, a needs assessment survey was administered to 79 expert teachers to gather comprehensive data for the development of the module.

Design and Development Phase: The researcher designed and developed the THINK Module based on the Sidek Module Development Model [18]. This phase involved the development of the THINK Module alongside other research instruments, including the HOTS test and the M-21CSI questionnaire to measure mastery of HOTS and 21st Century Skills. All instruments underwent a content validity assessment through expert consensus. A pilot study was then conducted to determine the reliability of these instruments before they were administered to the actual study sample.

Evaluation Phase: In this phase, an evaluation is conducted to assess whether the learning activities effectively facilitate the mastery of HOTS and 21st Century Skills among students. The research design employed in this study is a pre experimental method, specifically a one-shot case study, involving three groups representing different school categories. Each group receives the same treatment, and the dependent variables are measured to evaluate the effects of the treatment and the usability of the THINK Module.

The sampling for this pre-experimental one-shot case study involves Year 5 students and PJPK teachers. The study's sample consists of Year 5 students and PJPK teachers from three school categories SK, SJKC, and SJKT within the Central Seberang Perai District, Penang, who meet the study's inclusion criteria. A school from each category was selected through simple random sampling, and the study sample was subsequently chosen using cluster sampling. Three teachers and 93 students were selected across the three categories. The student sample was selected based on intact classes, where all students enrolled in the Year 5 Health Education subject, as determined by the teacher, were included. The development of the module took 10 months, encompassing both the needs analysis and design phases, which required expert consensus for its construction. The effectiveness study lasted 10 weeks, equivalent to 10 face-to-face hours and 9 video-sharing sessions for teaching and learning all Year 5 Health Education topics.

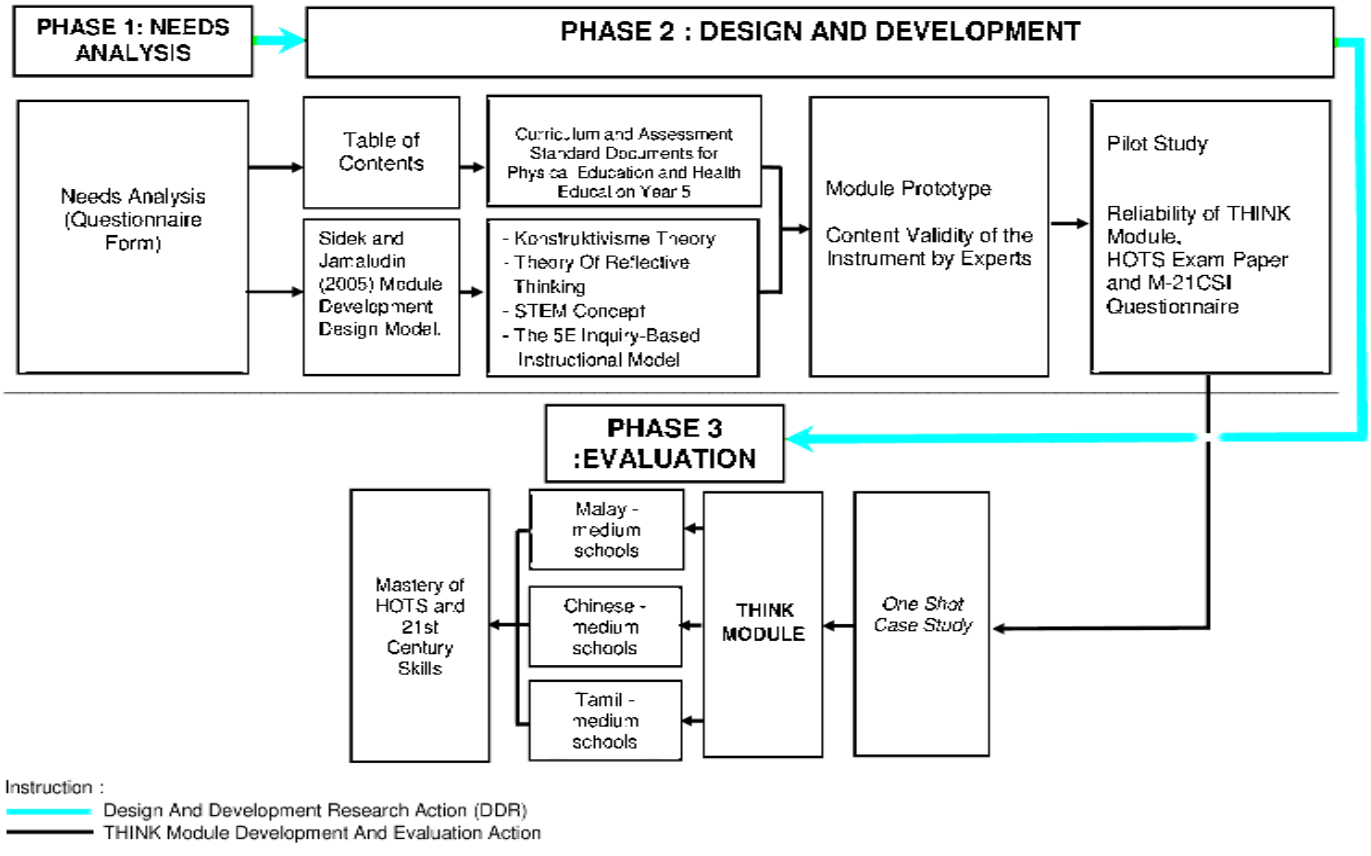


Fig. 1 Conceptual framework of the study [23]

# RESULT AND DISCUSSION

In this study, several research questions have been listed, including:

1. What is the need for developing the THINK module through the STEM approach for the Year 5 Health Education subject among Physical and Health Education teachers?
2. How suitable is the integration of STEM into the topics of the Year 5 Health Education subject?
3. Does the THINK teaching module based on the STEM approach for the Year 5 Health Education subject have good validity?
4. Does the THINK teaching module based on the STEM approach for the Year 5 Health Education subject have good reliability?
5. To what extent do students master and achieve Higher-Order Thinking Skills and 21st Century Skills using the THINK Module for the Year 5 Health Education subject, based on school categories?
6. Are there differences in students' mastery levels between Higher-Order Thinking Skills and 21st Century Skills using the THINK Module for the Year 5 Health Education subject, based on school categories?
7. Is there a relationship between students' achievement in Higher-Order Thinking Skills and 21st Century Skills using the THINK Module?

The researcher conducted a needs analysis to obtain information from PJPK subject teachers. The information collected focused on the need to integrate STEM in teaching and learning and the suitability of topics in the Health Education subject for developing a STEM-based project-based learning structure. Based on the findings of the study, the overall agreement score indicates a high agreement value of $r$ = .86 (n=79). All evaluators met the specified criteria and are subject matter experts in Physical Education and Health Education. These experts assessed the necessity of integrating STEM into the PJPK subject while considering the direction of the national education system. The overall score must exceed the value of .70 and is considered to have achieved or reached a high level of agreement [19]. The same findings were obtained by [13] who found a high percentage of agreement in constructing a STEM integration module for Mathematics. The percentage of agreement was calculated based on the content validity formula [18]. In conclusion, the achieved agreement scores indicate that the integration of STEM into the Physical Education and Health (PJPK) subject is crucial for enhancing students' understanding, as well as for fostering a more student-centered teaching and learning process, as outlined in the Malaysia Education Development Plan (PPPM) 2013–2025.

For the aspect of selecting suitable Health Education topics for Year 5 to develop a STEM teaching module, a topic needs analysis questionnaire was distributed along with the needs questionnaire to 79 PJPK expert teachers. The study findings show a high percentage agreement score from teachers regarding the suitability of integrating STEM into all topics in the Year 5 Health Education syllabus. All experts have evaluated the suitability of STEM integration into PJPK subject topics. The overall agreement score indicates a high value of $r$ = .91 (n=79). Therefore, this method has been utilized by [11] and [8] to evaluate the suitability of topics and projects for STEM integration. According to [11], this step is essential to ensure that the topics and projects in the STEM module meet the criteria of STEM education, which aims to cultivate creative, critical, systematic, and logical thinking [12]. Overall, it was found that all projects in the THINK Module and the integration of STEM into the Year 5 Health Education subject topics are highly suitable.

The THINK Module developed in this study is valid and suitable for use among Year 5 students, with the integration of STEM concepts into the Health Education subject. A good module validity coefficient (.90) was obtained through evaluation by experts in STEM education and Health Education. This indicates that the developed module can serve as a guide for implementing project-based learning with STEM integration in the classroom. The module, oriented toward inquiry-based learning, is structured according to five phases: engagement, exploration, explanation, elaboration, and evaluation. In summary, these phases represent the STEM teaching and learning process with an inquiry-based learning orientation adapted from the 5E Model [7]. The validity of the THINK Module is considered good as it exceeds the value of a good module validity coefficient (>.80) [18]. The findings of this study also align with those of [4], who developed the I-Think module using the Design and Development Research approach and the Sidek Development Model. His study found that the I-Think Algebraic Expressions training module achieved a high content validity percentage,

with a mean of 89.09%. Furthermore, [9] developed a teaching and learning module based on an inquiry-based teaching approach for the topics of Free Fall and Sliding Motion, and evaluated its effectiveness on students' achievement using the DDR method. The study's findings revealed that the Teaching and Learning module for the topics of Free Fall and Sliding Motion achieved a good average percentage of expert agreement, at 78.35%. In summary, the validity of the module is crucial to ensure that the module measures what it is intended to measure [18]. Moreover, the development of modules based on PBP (Problem-Based Learning) and STEM is agreed upon for implementation according to the phases of learning. This approach can guide students to apply their knowledge in problem-solving and in producing more systematic projects. Additionally, students are trained to ask questions, express curiosity, and engage in group investigations to validate the questions raised.

The reliability of the module was tested based on how well students were able to successfully follow the activity steps outlined in the module [18]. This ensures that students can achieve the predetermined objectives of the module. Therefore, the researcher developed a module reliability questionnaire based on the learning and facilitation steps in the THINK Module, namely engagement, exploration, explanation, elaboration, and evaluation. The students involved as the sample in the pilot study underwent teaching and learning using the THINK Module for six weeks. The pilot study was conducted with 30 students at a primary school in 2023. The students participated in all the activities suggested in the module and completed the module reliability questionnaire. The study findings show that the Cronbach Alpha value for the THINK Module is .94. This reliability coefficient value indicates very good reliability and is adequate for a research tool [6]. Therefore, the developed THINK Module can be considered a module with excellent reliability. The same findings were shown by [11]. The Cronbach's Alpha coefficient was obtained based on a questionnaire survey conducted on a pilot study sample that engaged in activities within the developed PRO STEM module. The reliability coefficient obtained for the PRO STEM module was 0.90, indicating excellent reliability.

The reliability study conducted on this module demonstrates that a module must have a high reliability value to ensure the quality and standards of the module, as well as to have a positive impact on the teaching and learning process. Additionally, good module reliability reflects the feasibility of the strategies used as the PdPc approach by students, who are the users of the module. Furthermore, the pilot study conducted allowed for a thorough examination of the module's suitability, reducing any unforeseen issues before the effectiveness testing of the module was carried out.

Table I Level of Mastery in Higher Order Thinking Skills of Year 5 Students for Health Education Subject by School Category

| School Category | Number of Students | Very Poor (0-19) | Poor (20-39) | Average (40-59) | Good (60-79) | Very Good (80-100) | Mean Test Score |
|---|---|---|---|---|---|---|---|
| **S K Machang Bubok 2** | 32 | 34.4% | 0% | 0% | 15.6% | 37.5% | 46.9% |
| **SJK (C) Kay Sin** | 31 | 33.3% | 0% | 3.2% | 16.1% | 41.9% | 38.7% |
| **SJK (T) Permatang Tinggi** | 30 | 32.3% | 0% | 0% | 23.3% | 40% | 36.7% |
| **Total** | **93** | **100%** | **0%** | **1.1%** | **18.3%** | **39.8%** | **40.9%** |

Table I shows the level of mastery in Higher Order Thinking Skills of Year 5 students for the Health Education subject by school category. The students' HOTS level was measured based on their scores in the HOTS test and divided into five mastery levels: very weak, weak, moderate, good, and very good. The study findings show that 38 students (40.9%) from the three schools achieved a very good HOTS mastery level. A total of 15 students from SK Machang Bubok 2 recorded the highest number of students at the very good HOTS level compared to only 12 students from SJK (C) Kay Sin and 11 students from SJK (T) Permatang Tinggi. Meanwhile, 37 students (39.8%) mastered the good HOTS level. Thirteen students from SJK (C) Kay Sin recorded the highest number at the good mastery level compared to only 12 students from SJK (T) Permatang Tinggi and SK Machang Bubok 2. A total of 17 students (18.3%) mastered the moderate level, with seven students from SJK (T) Permatang Tinggi recording the highest number compared to SJK (C) Kay Sin and SK Machang Bubok, which each recorded five students. Lastly, one student (1.1%) from SJKC Kay Sin achieved the weak mastery level. The overall mean score for the HOTS test recorded (M=70.60), indicating that the students' HOTS mastery level is at a good level.

This suggests that the approach used in the THINK Module can enhance students' higher-order thinking skills (HOTS), as student-centered learning is integrated into the teaching and learning process (PdPc). Students are also stimulated during the PdPc process through thinking skill questions, enabling them to act and perform correctly in the activities conducted. The PdPc process implemented through the THINK Module has trained them to use higher-order thinking, such as analyzing, applying, evaluating, and creating while producing projects. As such, the approach used (PBL STEM) encourages students to use inquiry in idea generation, product design selection, and product presentation. This argument is supported by [22], who state that activities in PBL STEM require HOTS as students are trained through the inquiry process. Through this process, students are encouraged to conduct investigations and argue using various problem-solving methods, which ultimately lead to a better understanding of the learning topic.

Table II Level of Mastery in 21st Century Skills of Year 5 Students for Health Education Subject by School Category

| School Category | Number of Students | Low (1.00-2.00) | Low Medium (2.01-3.00) | Medium High (3.01-4.00) | High (4.01-5.00) | Mean Score |
|---|---|---|---|---|---|---|
| **SK Machang Bubok 2** | 32 | 34.4% | 0% | 0% | 75% | 4.15 |
| **SJK (C) Kay Sin** | 31 | 33.3% | 0% | 0% | 87.1% | 4.22 |
| **SJK (T) Permatang Tinggi** | 30 | 32.3% | 0% | 0% | 76.7% | 4.20 |
| **Overall Total** | **93** | **100%** | **0%** | **0%** | **79.6%** | **4.19** |

Table II shows the level of mastery in 21st-Century Skills of Year 5 students for the Health Education subject by school category. The level of 21st Century Skills of students was measured based on the mean score of students in answering the M-21CSI questionnaire and was divided into four levels of mastery: low, low-medium, medium-high, and high. The study findings show that 74 students (79.6%) from the three schools achieved a high level of mastery in 21st Century Skills. A total of 27 students from SJKC Kay Sin recorded the highest number at the high mastery level, compared to only 24 students from SK Machang Bubok 2 and 23 students from SJK (T) Permatang Tinggi. Meanwhile, 19 students (20.4%) achieved a medium-high level of mastery in 21st Century Skills. Eight students from SK Machang Bubok 2 recorded the highest number at the medium-high mastery level, followed by seven students from SJK (T) Permatang Tinggi and four students from SJKC Kay Sin. In conclusion, the overall mean score for the M-21CSI questionnaire recorded (M=4.19), indicating that the students' mastery of 21st Century Skills is at a high level.

The findings of the study indicate that the PdPc process with the THINK Module has a positive impact on students' mastery of 21st-century skills and is significantly effective. This is because the integration of design skills, practiced by students through the PBL STEM approach, fosters skills such as communication among peers and teachers, the ability to access and evaluate information from digital/internet sources, innovation through the creation of innovative products, the production of engaging animated videos, as well as the ability to apply problem-solving strategies. This is also argued by [24], who state that the cultivation of 21st-century skills requires a 21st-century teaching approach through activities that stimulate critical thinking.

A one-way ANOVA test was conducted to determine whether there were significant differences in students' mastery level of HOTS based on school categories, using the THINK Module grounded in the STEM approach for Year 5 Health Education. The one-way ANOVA was performed to examine the differences in HOTS achievement scores among National Schools, Chinese National-Type Schools, and Tamil National-Type Schools. The data analysis indicated no significant difference at $p > 0.05$, $F(2,90) = .181$, $p = .835$. In conclusion, there is no significant difference in the mean HOTS scores among National Schools, Chinese National-Type Schools, and Tamil National-Type Schools.

Subsequently, a one-way ANOVA test was conducted to determine whether there were significant differences in the mastery level of 21st Century Skills based on school categories, using the THINK Module grounded in the STEM approach for Year 5 Health Education. The one-way ANOVA was performed to assess differences in the achievement level of 21st Century Skills among National Schools, Chinese National-Type Schools, and Tamil National-Type Schools. The data analysis revealed no significant difference at $p > 0.05$, $F(2,90) = .725$, $p = .487$. In conclusion, there is no significant difference in the mean scores for 21st Century Skills among

National Schools, Chinese National-Type Schools, and Tamil National-Type Schools. The findings indicate several factors that influence the results of the study. The most important factor is that all three school categories used the same Year 5 Health Education (HE) curriculum. HE teachers are required to teach Health Education based on the syllabus set by the Ministry of Education Malaysia [1]. This finding is supported by a study conducted by [16] on three categories of secondary schools, consisting of fully residential schools, daily schools, and religious schools. The study's findings showed no significant differences in the overall learning achievement among the three school categories, as they all used the same Physical Education curriculum.

Although there were differences in the medium of instruction across the three school categories, it did not affect the students' level of mastery in learning when using the THINK Module for Year 5 Health Education. This indicates that the THINK Module is suitable for use in the teaching and learning process of Health Education to enhance students' abilities in mastering HOTS and 21st-century skills, in line with the objectives and goals outlined in the Year 5 Physical Education and Health Education Curriculum (DSKP).

Another factor influencing the study's results is the implementation of teaching by teachers, which followed the guidelines set in the THINK Module. This is because, before the actual teaching sessions, all involved teachers were given a 2-week briefing to master the THINK Module's teaching methods, which emphasize the STEM concept. This ensures that teachers understand and then implement the correct teaching methods as outlined in the THINK Module. The use of the same materials and approach allows for easier, accurate, clear, and consistent delivery of learning, ensuring alignment with the main objectives and goals of the lesson.

The researcher employed Pearson's correlation coefficient to analyze the relationship between Higher-Order Thinking Skills and 21st Century Skills. The findings reveal that the Pearson correlation coefficient, *r*, for the relationship between HOTS and 21st Century Skills is .024 ($r = .024$). This indicates that the two variables do not exhibit a positive relationship and have no correlation [3]. The findings of this study indicate that students who demonstrate a high level of mastery in HOTS do not necessarily possess high 21st-century skills. The production of a product requires a high level of commitment from students to ensure that the final product is of the best quality. Some of the student groups involved demonstrated good understanding and application of the concepts. However, there are still groups of students who require teacher support and further practice to understand and apply the STEM concepts learned in the project production process. This argument is also supported by [17], who state that students' personalities in terms of attitude, interest, and motivation influence their academic mastery level, and they constantly require additional encouragement and practice to better engage in the teaching and learning process.

The findings indicate that the teaching and learning process using the THINK Module has a positive impact on students' mastery of 21st Century Skills and HOTS is significantly effective. This is due to the integration of design skills practiced by students through the project-based STEM approach, which fosters various skills such as communication with peers and teachers, the ability to access and evaluate information from digital/internet sources, innovation in creating innovative products, the production of engaging animated videos, and the capability to apply problem-solving strategies.

## CONCLUSION

Before adopting student-centered teaching and learning approaches, educators can utilize a support tool known as modular teaching to ensure thorough preparation. This preparation includes ensuring readiness to incorporate the latest teaching aids in alignment with advancements in 21st century pedagogy and HOTS. Promoting a healthy lifestyle is also emphasized, aiming to cultivate well-rounded individuals capable of competing on a global scale. The foundation of a healthy lifestyle requires a comprehensive understanding of health, physical fitness, and balanced nutrition. Students who engage with health-related content generally demonstrate a greater understanding of health compared to those who do not. Furthermore, the development of this module presents multiple benefits for various stakeholders. It serves to disseminate knowledge regarding healthy lifestyle practices within the broader community and provides valuable insights to the Malaysian Ministry of Education for the enhancement of primary school curriculam. Teachers can use this module as a resource and guide to implement interventions designed to foster student engagement and expertise in

maintaining a healthy lifestyle. Additionally, it may serve as a reference for other researchers exploring similar or different fields of study.

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