

# Enhancing Student Understanding and Engagement in Nutrition and Dietary Topics Through the Implementation of Gamified Integrated Learning Modules

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## Abstract

This study explores the effectiveness of integrated learning modules in enhancing student understanding and engagement in nutrition and dietary topics. A quantitative approach was employed with purposive sampling to ensure data was derived from participants' existing knowledge. Data collection methods included interview questions, as well as pre- and post-tests conducted after the learning sessions. The participants consisted of 20 students from in Negeri Sembilan. Data analysis was carried out using statistical methods such as descriptive statistics and thematic analysis. The findings revealed a significant increase in students' interest and understanding of the Nutrition and Dietary topic after being taught using a Gamified Integrated Learning Module (GILM), which combined multidisciplinary elements of Biology and Health Education. Students also demonstrated a more positive attitude, with greater engagement in class activities and enthusiasm for the teaching aids utilized. The study confirmed that collaborative and gamified, student-centered learning approaches effectively enhance interest and comprehension levels. Therefore, educators are encouraged to adopt teaching strategies tailored to individual learning styles and to creatively adapt methods that resonate with students. Continuous reflection on teaching practices is recommended to ensure consistent improvement, ultimately fostering better student interest and understanding in key subject areas.

**Keywords:** Multidisciplinary, Integrated Module, Collaborative, Gamification, Biology, Health Science

## Introduction

In recent years, poor dietary habits have become a critical concern among young people worldwide, with studies showing that nearly 80% of adolescents fail to meet recommended daily intake levels of fruits and vegetables (World Health Organization, 2023). This alarming trend not only impacts their immediate health but also sets the stage for chronic diseases such as obesity, diabetes, and cardiovascular issues in adulthood. With the growing

prevalence of unhealthy eating behaviors, equipping students with strong foundational knowledge of nutrition and encouraging better dietary choices have become urgent priorities. Biology is introduced in secondary school, pre-university, and higher education curricula in Malaysia. It is a field of study that examines living organisms, physiological processes, and natural phenomena. A deep understanding of physiological processes in animals and plants requires a high level of knowledge due to its abstract nature. The complexity of the subject matter often makes effective learning challenging. Effective learning processes enable students to make progress in their education. Studies have shown that the lack of learning models capable of increasing students' interest, activity, and learning outcomes is a challenge in the education system (Dewantari & Singgih, 2020). Conventional teaching methods tend to be less interactive between teachers and students and are often perceived as monotonous. One of the topics in Biology that is closely related to other subjects is Nutrition. The Nutrition topic is strongly tied to issues of diet and eating habits. This topic is also studied in Health Education subjects at both primary and secondary school levels. This highlights the importance of the topic in daily life, aligning with current technological advancements. Since both topics share a common theme, integrating multidisciplinary learning concepts is a practical approach to helping students build a comprehensive understanding. The concept of a multidisciplinary curriculum integrates several fields of knowledge into a single curriculum. Its purpose is to enrich students' learning experiences and help them understand how different disciplines are interconnected and influence each other. In a multidisciplinary curriculum, students can explore broader and more complex topics, fostering their critical and creative thinking skills (Norlidah et al., 2014).

Traditional approaches to teaching nutrition typically rely on lectures, printed materials, and static presentations, which often fail to capture students' interest or foster long-term engagement. These methods, while informative, lack interactivity and fail to connect with students on a practical, everyday level. Consequently, many students perceive nutrition education as abstract and unrelatable, undermining its potential to drive meaningful changes in behavior. This gap highlights the need for a more dynamic and engaging approach to teaching nutrition.

To address this challenge, there is a growing demand for innovative teaching tools that not only convey essential knowledge but also actively engage students in the learning process. One promising solution lies in the incorporation of gamified learning strategies, which combine elements of gaming—such as challenges, rewards, and interactive storytelling—with educational content. These strategies have demonstrated effectiveness in other educational fields, fostering higher engagement, motivation, and retention rates. However, their potential in the context of nutrition education remains underexplored.

In this study, we applied these methods by integrating two subjects: Form 4 Biology and Form 5 Physical Education and Health Education. Learning activities were planned and conducted simultaneously among students from these two different levels to facilitate collaborative and cooperative learning approaches. This study seeks to bridge this gap by developing and evaluating gamified integrated learning modules tailored to nutrition and dietary topics. The research aims to assess whether these modules enhance student understanding, engagement, and application of nutritional knowledge compared to traditional methods. By

leveraging the principles of gamification, the study aspires to create a more interactive and impactful learning experience for students.

### **Initial Reflection**

#### *Observation of Student Behaviour*

Based on reflections from past teaching and learning (T&L) sessions, observations revealed that students faced challenges in building a solid understanding of concepts in Biology and Health Education. These observations were systematically documented using a Student Behaviour Observation Form, which comprised a checklist of 10 thematic questions focusing on student behaviour during different stages of the learning activities. The checklist evaluated several key aspects, including students' attitudes and communication skills, interest and focus, and participation in group activities.

Students' interactions with peers and teachers were observed to assess their willingness to communicate, seek clarification, and contribute ideas during discussions. Their level of interest in the lesson topics and their ability to maintain focus throughout the learning sessions were also examined. Additionally, their engagement in collaborative group activities was monitored, focusing on their involvement, cooperation, and initiative in taking on leadership roles.

The findings highlighted that student often struggled with active engagement, effective communication, and sustained interest in the lessons. These challenges underscored the need for a more collaborative, interactive, and gamified learning approach to enhance communication, foster interest, and encourage active participation. Such an approach would better align with students' needs and improve their learning outcomes.

#### *Document Analysis of Scores*

The researcher also conducted a problem survey based on the study's objectives by collecting initial student score data to gain an overview of their current performance. The findings indicated that students' understanding of the topics of nutrition and diet was low and unsatisfactory, despite these two interrelated topics being repeatedly taught in two different subjects, namely Form 4 Biology and Form 5 Health Education.

#### *Interviews*

To gain an initial understanding of students' interest in the subject, their engagement in class, and their level of comprehension, an early survey was conducted through interviews. The results revealed that 30% of students expressed enjoyment in learning about the topics of Nutrition and Diet. However, only 20% of students frequently asked questions during class, indicating a low level of engagement in teaching and learning activities.

Students' ability to answer questions posed by the teacher during lessons provided insight into their understanding during class. According to the survey, only 10% of students acknowledged actively participating in class through question-and-answer sessions with the teacher. Additionally, interest in and the perceived effectiveness of teaching aids (ABM) remained low, both at 20%.

Students also suggested several preferred teaching and learning methods. Among the proposed methods were collaborative learning, such as group discussions, game-based learning, and technology-enhanced learning. As a result, this action research employed the Gamified Integrated Learning Module (GLIM) for Biology and Health Education, which incorporates collaborative and gamification elements to enhance students' interest and understanding of the topics of Nutrition (Biology) and Diet (Health Education).

### **Focus of the Study**

This study focuses on addressing the challenges faced by secondary school students, particularly those in Form 4 and Form 5, in mastering the topics of Nutrition and Diet. These topics were selected based on initial surveys and analysis of students' summative test scores, which revealed a lack of interest in teaching methods, dissatisfaction with the teaching aids used, and low levels of classroom participation. Consequently, students faced difficulties in understanding these topics.

The researcher also selected this study topic based on prior research, such as Mogre et al. (2018), who examined students' perspectives on barriers and strategies to improve nutrition education within the curriculum. Their findings highlighted the need for innovative teaching methods and the early integration of nutrition topics throughout the curriculum to enhance student understanding.

This research aims to address these issues by implementing innovative, engaging, and student-centered teaching approaches to improve students' interest, participation, and comprehension in the topics of Nutrition and Diet. The sample for this study consists of 20 secondary school students aged 16 and 17 years old.

This study aims to enhance students' interest and understanding of the topics of Nutrition and Diet. Specifically, it seeks to improve students' comprehension of these topics through the implementation of the Gamified Integrated Learning Module (GLIM) for Biology and Health Education. Additionally, the study aims to increase students' interest in these topics by leveraging the same integrated learning module, which incorporates innovative, collaborative, and gamified teaching approaches to make the learning experience more engaging and effective.

### **Research Design**

This study adopts a qualitative descriptive approach, with the primary instrument being the Gamified Integrated Learning Module (GLIM) for Biology and Health Education. Data collection methods include interviews, pre- and post-tests, and an observation checklist. To address the first research objective, the researcher utilized pre- and post-test instruments, while interviews and observations were employed for the second objective. All instruments were used to gather data and information from the study participants.

The study integrates the Kemmis & McTaggart Model as its primary framework, complemented by elements of the CRASP Zuber-Skerritt Model to emphasize collaborative practices. While the Kemmis & McTaggart Model provides a structured and cyclical process designed for the effective implementation and evaluation of educational innovations, the

CRASP Zuber-Skerritt Model offers additional collaborative elements that align well with the study's goals.

This action research combines the collaborative elements of the CRASP Zuber-Skerritt Model and the structured, iterative processes of the Kemmis & McTaggart Model as the conceptual framework. This is particularly relevant as the GLIM module is a collaborative effort of two subjects: Biology and Health Education. This combined framework ensures a holistic approach to developing, implementing, and evaluating the module's impact on student learning.

#### *Planning Phase*

The planning phase began with a comprehensive evaluation of current educational strategies and student needs. Collaboration between the Biology and Health Education teachers was central to integrating both topics into the curriculum. This approach ensured that the content was not only educationally rich but also engaging and relevant for students with diverse learning styles (Kemmis & McTaggart, 2005).

#### *Action Phase*

During the action phase, the module was implemented in the classroom, where students participated in planned activities. These included digital games simulating nutrition-related scenarios using the Minecraft application, group challenges to create healthy meal plans, and interactive quizzes on nutritional facts. These collaborative activities aimed to foster a deeper understanding and practical application of nutritional knowledge while encouraging students to interact, discuss, and learn from one another. Teachers carefully observed these interactions and monitored student engagement, collecting data through direct observations, student feedback, and performance assessments. This hands-on approach evaluated the practical impact of gamification, multidisciplinary curriculum integration, and collaborative strategies on learning outcomes.

#### *Reflection Phase*

The reflection phase in the Kemmis & McTaggart model enabled educators to critically assess the effectiveness of the module. This involved analysing collected data to determine which aspects of the module were most effective in enhancing student learning and identifying areas for improvement. Findings might include the need for more diverse game mechanics to cater to different learning preferences or adjustments to collaborative tasks to ensure active participation from all students.

This reflection was then used to refine the module, incorporating adjustments based on both quantitative and qualitative feedback from students and educators. This iterative process emphasized continuous improvement, ensuring that educational strategies remained dynamic and responsive to student needs, ultimately enhancing the overall educational experience (Kemmis, McTaggart, & Nixon, 2014).

#### *Action Planning*

The activities and approaches in this study were organized based on the identified issues and the goals to be achieved. From the literature review and initial surveys, four main issues emerged as the focus of this action research. First, students demonstrated a lack of interest in lessons and found conventional teaching methods and tools unengaging. Second, the topics

of Nutrition and Diet, which share similar content themes, were taught separately in two different subjects, Biology and Health Education, leading to redundancy and a fragmented learning experience. Third, students exhibited minimal engagement during lessons, with low levels of participation and involvement, indicating a lack of connection with the teaching and learning process. Lastly, students' comprehension and mastery of the topics were weak, as reflected in their summative test scores and classroom observations.

To address these issues, a comprehensive action plan was developed. This plan involved integrating the topics into a single multidisciplinary module, incorporating collaborative and gamified learning approaches, and utilizing innovative teaching aids such as digital games, group challenges, and interactive tools. These strategies were designed to enhance students' interest, engagement, and understanding, while providing a cohesive and dynamic learning experience.

Landers' Gamification Learning Theory emphasizes the use of game attributes outside the context of games to influence behaviours and attitudes related to learning (Tahir et al., 2022). By combining game elements, instructional content, and modifications to attitudes and behaviours, educators can create engaging learning experiences that foster cognitive development and positive learning outcomes.

The selected topics, Nutrition and Diet, are from two different subjects: Nutrition is taught in Biology during Form 4, while Diet is covered in Health Education during Form 5. Since students face challenges with these topics, which share a common theme, the use of an integrated learning module is deemed suitable to assist them.

Student engagement and interaction in class have been observed to be unsatisfactory, raising concerns among educators. Collaborative learning promotes peer interaction, problem-solving, and knowledge sharing, fostering deeper understanding and engagement with the learning materials (Armstrong & Landers, 2018). By incorporating elements of social interaction and cooperation, educators can create a supportive and interactive learning environment that motivates students to actively participate and learn collaboratively (Aubert & Friedrich, 2021).

Thus, the action plan has been structured to integrate all these strategies, combining gamification, instructional integration, and collaborative learning approaches to enhance student engagement and comprehension effectively.

#### *Intervention Implementation*

The intervention for the study participants was conducted over four learning sessions. Each session lasted between 1 to 2 hours, during which the participants were taught according to a carefully designed teaching plan.

The sessions incorporated activities and strategies from the Gamified Integrated Learning Module (GLIM), emphasizing gamification, collaboration, and interactive learning. The structured sessions ensured that students engaged actively and progressively in the topics of Nutrition and Diet, while fostering understanding and maintaining their interest throughout the intervention.



**Data Collection**

In this study, data was collected through three primary methods: a student behaviour observation checklist, interviews, and pre- and post-tests. Each instrument was utilized at different stages, tailored to its specific purpose and objectives. The first instrument employed was interview questions, conducted to gain an initial understanding of the research problem. Observations were also carried out during a regular learning session that employed conventional teaching methods. For observational data, a Student Behaviour Observation Checklist was used to record students' behaviour and engagement during the session.

Before the intervention sessions began, participants were required to complete a pre-test comprising 30 multiple-choice questions. This pre-test served as a baseline to assess participants' prior knowledge and understanding of the topics before the teaching and learning process commenced.

During the teaching and learning sessions, students' attitudes and behaviours were recorded again using the same observation checklist to track any changes or improvements. After the learning sessions concluded, participants were required to complete a post-test, which served as a follow-up assessment to measure any changes in their mastery and understanding of the topics. Additionally, selected participants were interviewed to gather feedback about their experiences during the sessions.

This multi-method approach ensured a comprehensive evaluation of the intervention's impact, combining qualitative and quantitative data to provide a holistic view of the outcomes.

**Findings**

Based on observations conducted after the intervention, participants showed increased confidence in responding to verbal questions posed by the teacher. They answered clearly and enthusiastically when questioned. Students were also able to identify inaccurate information deliberately presented by the teacher to test their focus and level of understanding. The classroom environment became more engaging and livelier, with students actively participating in discussions. This indicated a significant improvement in their confidence, attentiveness, and comprehension, contributing to a more dynamic and interactive learning experience.

Following the implementation of the intervention, there was a marked increase in interaction within student groups as well as two-way communication between students and the teacher. This indicates that the intervention successfully fostered positive classroom behaviours. These findings align with Vygotsky's Social Development Theory, which emphasizes the role of social interaction, the Zone of Proximal Development (ZPD), and scaffolding in learning.

Vygotsky's theory highlights the importance of social and cultural contexts in education, underlining the value of collaborative learning and guidance from more knowledgeable others to advance students' cognitive development (Cristofano et al., 2016). Collaborative learning activities designed in alignment with ZPD principles and scaffolding create

environments where students engage in meaningful interactions, receive tailored support, and work together to solve problems and achieve learning objectives (Gutmann et al., 2018). By encouraging collaborative learning experiences that challenge students within their ZPD, educators not only enhance cognitive abilities but also foster deeper interest in learning and a positive attitude towards education (Fourie, 2013). This underscores the effectiveness of the intervention in creating a supportive and dynamic learning environment that promotes both academic and social development.

#### *Post-Test Results*

The post-test was conducted immediately after the learning sessions concluded to ensure that the scores accurately reflected the students' knowledge and understanding following the implementation of the Gamified Integrated Learning Module. The results indicated a significant improvement in student performance, demonstrating an increase in their knowledge and comprehension of the multidisciplinary topic of Nutrition.

Overall, there was a noticeable rise in the total scores achieved by students before and after the learning sessions. All participants in the study showed an improvement in their post-test scores, further confirming the effectiveness of the intervention in enhancing students' understanding and mastery of the topics. This positive outcome underscores the success of the module in addressing the identified learning challenges and achieving the study's objectives.

Collaborative activities in teaching play a vital role in improving student learning outcomes and fostering a deeper understanding of the subject matter. Research has shown that collaborative learning activities, such as lesson study, have a significant impact on both teacher professional development and student learning experiences (Saparuddin, 2024). Lesson study involves teachers working together to plan, teach, reflect on, and refine lessons, leading to improved teaching practices and greater student engagement (Handayani & Triyanto, 2022).

These findings align with Vygotsky's Social Development Theory, which emphasizes the role of social interaction and cultural context in learning. Vygotsky's theory highlights the importance of collaborative learning and guidance from more knowledgeable individuals in advancing students' cognitive development (Cristofano et al., 2016). Collaborative learning fosters meaningful interaction, peer support, and shared problem-solving, ultimately enhancing understanding and creating a more engaging and supportive learning environment.

By incorporating collaborative approaches, educators can not only improve their teaching practices but also create opportunities for students to actively engage and develop critical thinking and problem-solving skills, which are essential for deeper learning and academic success.

Interviews with the study participants revealed improvements across all aspects of the research, including students' interest in the subject and the teaching aids used, their attitudes, level of understanding, and the effectiveness of teaching aids following the



implementation of the Gamified Integrated Learning Module. Among these, the students' level of understanding showed the highest improvement compared to other components.

Participants expressed particular interest in the use of multimedia and Minecraft for learning activities and assessments. Game-like features such as challenges, rewards, and interactive elements integrated into the instructional content were found to significantly enhance student engagement and motivation (Marquez & Bauer, 2020).

Furthermore, the integration of collaborative learning strategies within the gamification framework further enhanced students' cognitive abilities and fostered positive attitudes toward education (Tahir et al., 2021). Collaborative learning encouraged peer interaction, problem-solving, and knowledge sharing, promoting deeper understanding and active engagement with the learning material (Armstrong & Landers, 2018). By incorporating social interaction and cooperation elements, educators were able to create a supportive and interactive learning environment that motivated students to actively participate and engage in collaborative learning (Aubert & Friedrich, 2021).

These findings highlight the effectiveness of the Gamified Integrated Learning Module in leveraging gamification and collaborative learning to improve students' learning experiences, comprehension, and overall attitudes toward education.

### **Reflection**

The primary objective was to enhance students' understanding and interest in the subject through the use of interactive and engaging learning materials, such as videos, interactive quizzes, and collaborative activities. During the planning phase, we realized the importance of understanding students' backgrounds and needs to ensure the developed module aligns with their interests and requirements. Collaboration with colleagues and curriculum experts was critical in maintaining the quality of the module and action plan. Initial surveys and interviews with students helped identify key areas to emphasize in this action research.

During the implementation phase, the integrated learning module was applied over several learning sessions. Students explored the topic of nutrition through planned activities that allowed them to connect the knowledge acquired with their daily lives. One challenge encountered was the variation in students' reception and learning styles. While some students showed significant improvements in interest and understanding, others struggled to adapt to the more interactive learning approach. Real-time adjustments were made based on direct observations and student feedback. Activities such as group discussions and project-based learning proved effective in enhancing collaboration and communication among students.

After implementing the module, the reflection phase enabled us to evaluate the impact of the action research. Data collected through observations, pre- and post-tests, and student feedback showed significant improvements in students' attitudes, understanding, and interest in the subject. However, this reflection also highlighted areas for further improvement, particularly in adapting the module to support students struggling with active learning approaches. We plan to revise parts of the module to make it more inclusive and engaging. This action research has provided valuable insights into the effectiveness of

integrated learning approaches and the importance of flexible, responsive strategies in education, especially for topics like Nutrition and Diet.

The outcomes of this study hold significant implications for multiple stakeholders. For students, it offers an engaging way to build critical life skills in nutrition. For educators, it provides a practical and innovative tool to enhance curriculum delivery. Public health practitioners may benefit from the long-term behavioral changes encouraged by this approach, contributing to improved community health outcomes. Moreover, the findings could inform policymakers and curriculum developers, encouraging investment in modern, gamified educational technologies that align with broader public health and educational goals. This research not only advances the academic understanding of gamified education but also addresses a pressing real-world challenge, ensuring its relevance and impact.

### **Recommendations for Future Research**

Given that this research was conducted in a single cycle, we recommend continuing this action research into a second and subsequent cycles, incorporating reflections from the initial cycle. the Gamified Integrated Learning Module (GLIM) could be further improved by including additional topics or subtopics that align with the shared themes between Biology and Health Education. Integrating more multidisciplinary topics from both subjects can enhance the educational value of the module, fostering a more holistic understanding among students. Future research could also focus on developing collaborative processes among experts in different fields or subjects. This includes exploring the best methods to facilitate interdisciplinary collaboration and strategies to ensure equitable contributions from each discipline in creating other multidisciplinary modules. These modules could encourage gamified and collaborative learning activities and assessments.

Additionally, future studies could focus on creating more interactive and dynamic modules leveraging information and communication technologies to provide a more integrated learning experience. Unlike the current the Gamified Integrated Learning Module (GLIM), which incorporates only the Minecraft application, other modules could include online learning platforms, educational games, or other interactive simulations.

Lastly, addressing ethical and cultural issues is crucial as multidisciplinary modules involve various fields and may touch on sensitive topics from multiple perspectives. Future research could explore strategies to promote understanding and tolerance of cultural differences and viewpoints within the learning context. This includes exploring methods to handle ethical and cultural issues effectively in module development.

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