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Project-Based Learning Innovation: Developing Nutritional Literacy through *Moringa* (*Moringa oleifera*) Leaf Pudding Making

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ABSTRACT The low nutritional literacy of students and the underutilization of moringa leaves (Moringa oleifera) as contextual teaching materials in the form of foods, such as pudding, pose challenges to increasing nutritional awareness from an early age. This study aims to analyze the development of students' nutritional literacy following the implementation of a project-based learning activity on making pudding from *Moringa oleifera* leaves. The study employs a quantitative method with a one-shot case study design. The research subjects were 36 eleventh-grade students at a senior high school in West Java. The learning activity was conducted in the form of a moringa leaf pudding-making project designed to integrate chemistry concepts (colloids) and nutritional literacy in an applied manner. Nutrition literacy includes four primary indicators: content, context, process, and attitude. The research findings revealed an overall average score of 94, which is categorized as very good. Detailed scores for content, context, process, and attitude are 84, 94, 99, and 100, respectively. This research shows that project-based learning across three sessions can develop students' nutritional literacy through contextual, practical learning experiences.

Keywords: Moringa leaf, Nutrition literacy, Project-based learning, Pudding

1. INTRODUCTION

In the digital era, information about health and nutrition is easily accessible. (Nursiah, 2024), but not all information is accurate (Denniss et al. 2023). This can cause a person to choose an unbalanced diet. (Amalia et al., 2023) resulting in nutritional needs not being adequately met (Aulia, 2021). Therefore, a skill is needed to filter this information: namely, nutritional literacy. (Mansfield et al. 2020). According to (Gibbs et al., 2016)Nutritional literacy is the level at which a person can obtain, process, and understand nutritional information and the skills needed to make informed nutritional decisions. However, data presented by Hanun, (2022) shows that students' nutritional literacy is relatively low. As many as 58.8% of cases fall into the low category. This indicates that students' nutritional literacy is relatively low (Pradita et al., 2023) .

The situation contributes to the high prevalence of various nutritional problems. Low nutritional literacy among students is also one of the factors contributing to the increase in malnutrition cases, according to the Ministry of Health of the Republic of Indonesia (RI), both in the form of malnutrition and obesity. According to the Ministry of Health of the Republic of Indonesia (RI), through the 2024 Indonesia Nutrition Status Survey, the prevalence of stunting in Indonesia remains high at 19.8% (Lestarini et al., 2024). Meanwhile, the National Research and Innovation Agency, through the 2023 Indonesia Health Survey, indicates that approximately 19.7% of children aged 5-12 years and 16% of children aged 13-15 years are overweight or obese. This is one of the factors causing the increasing number of malnutrition cases, according to the Ministry of Health of the Republic of Indonesia, both in the form of malnutrition and obesity.

Project-based learning is one of the learning models that can develop students' skills thoroughly (Quinapallo-quintana & Quinapallo-quintana, 2024). This learning model encourages an in-depth understanding of concepts (Eckardt et al., 2020) and the application of knowledge in real-world contexts (Fitri et al., 2024), thereby creating a

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meaningful learning experience (Ramadhan & Hindun, 2023). Using the learning model effectively, supported by appropriate teaching materials, can help students understand the material in depth.

One of the chemical materials studied in high school is colloids. This topic is not only theoretical but also applicable in everyday life (Parera et al., 2022), making it highly relevant for project-based learning (Agustina et al., 2025). In the context of developing nutritional literacy, the connection between chemistry and food is crucial to introduce to students. One example is pudding, which, in addition to being a nutritious food product, also serves as an example of a gel-type colloidal system in chemistry (Marfu'ah & Meristin, 2022), with the dispersed phase being agar-agar (solid) and the dispersing medium being water (liquid) (Herawati, 2018). Pudding was chosen as a nutritional preparation because it is easy to make and is favored by various groups (Srimiati et al., 2023). Moreover, pudding is easy to package in small portions and can be used as a practical example in nutrition education, both in schools and in the community. The use of Moringa leaves (*Moringa oleifera*) in pudding making as a food additive is beneficial because of their content, such as protein, vitamin A, calcium, iron, and antioxidants, which are very beneficial for growth and the prevention of malnutrition (Islam et al., 2021). The use of student worksheets as teaching materials can also improve students' understanding of concepts, in addition to the use of package books in general (Nomleni et al., 2024). Using the learning model effectively, supported by appropriate teaching materials, can help students understand the material in depth.

Previous research on nutritional literacy has been conducted by Azzahra (2024) who implemented project-based learning on making fruit juice from fruit peels. The results revealed that students' nutritional literacy was categorized as very good, with an average score of 80. However, the research conducted is only in the form of thesis output and has not been published in scientific articles. Research on making pudding with the addition of moringa leaves has been conducted previously, as shown in a study by Rianasari et al., (2024) who developed moringa leaf-based pudding as a high-nutrient food alternative. Based on the explanation above, the utilization of moringa leaves in pudding has been done before, but there has been no application in learning. In this study, an innovation was introduced in the form of a moringa leaf pudding (*Moringa oleifera)* product. In addition, the target community in the study has not been described in detail, so the scope and impact on the educational community or society are not yet clearly understood. In this study, the focus is not only on developing students' nutritional literacy through processed foods (moringa leaf pudding), but also on targeting communities in society.

Therefore, it is necessary to carry out a practicum regarding the making of pudding from moringa leaves to overcome the problem of the lack of nutritional literacy of students. Pudding made from moringa leaves (*Moringa oleifera*) was chosen because it has a more complete nutritional profile and higher levels of protein, iron, vitamins, and antioxidants, which are very important for adolescent growth and health. This step also reflects the concept of *rahmatan lil alamin*, as through this learning, students not only gain knowledge of nutrition and health but also understand the importance of managing natural resources wisely and sustainably.

This study aims to develop students' nutritional literacy through the application of project-based learning in making pudding from moringa leaves (*Moringa oleifera*). The benefits of this research are not only felt by students in the form of improved nutritional understanding, scientific process skills, and a caring attitude toward health, but also have a positive impact on the community through the introduction of nutritious local products that have the potential to be developed as functional food alternatives to support efforts to improve health.

2. METHOD

This research was conducted at a high school in West Java Province in April 2025. The subject of the research was the XI grade students of senior high school in West Java Province in the chemistry subject of colloid material. Samples were selected randomly (random sampling) to avoid bias in participant selection and ensure that every student had an equal opportunity to participate in the study. The study included 36 students, divided into five groups. This division aims to facilitate group work during the learning process, enabling students to collaborate in designing, creating, and evaluating products. The instruments used included student activity observation sheets, students' worksheets, assessment rubrics, and nutritional literacy tests. Where student activity observation sheets are used to assess engagement during learning, student serve as both a guide and a tool to measure critical thinking abilities and process skills, assessment guidelines are used to evaluate student products and performance objectively, and nutrition literacy tests are employed to measure students' nutrition literacy levels based on content, context, process, and attitude aspects, which were carried out after the learning was complete and done individually. The nutritional literacy test, in the form of an essay, totaling 10 questions, has been adjusted to include four nutritional literacy indicators aligned with science literacy indicators: content, context, process, and attitude.

Before being applied to students, instruments such as project-based worksheets, nutrition literacy test questions, and other instruments were first validated by two lecturers specializing in chemistry education and one chemistry teacher. The validity of the instruments in this study was used to determine whether the instruments used by the researchers could measure the abilities they were intended

to measure. The validation of this research instrument was conducted from March 21 to April 21, 2025, and yielded an average score of 90, indicating excellent performance. This indicates that the instrument used in this study meets the criteria for research use and that the validators' suggestions have been considered and implemented to improve the instrument's overall quality.

In this study, the approach is quantitative. According to Sugiyono, (2015)The quantitative approach is a systematic research approach that emphasizes the collection and analysis of numerical data to understand phenomena, make predictions, and inform decision-making. The method used in this research is a pre-experiment with a one-shot case study design. This design uses experimental design in general; it is just that it does not use a control group as a comparison (Ratminingsih, 2017). After that, validation of the nutrition literacy test instrument was calculated using the Aiken formula, with a score of 1-4 given to each question item referring to science literacy indicators. The aspects measured are scientific competence, subject knowledge, question context, spelling, and the clarity and language of question instructions. Validity, according to Aiken, can be said to be good if the Aiken index is greater than 0.75. The Aiken validity index is declared low if the value is below 0.4, medium if 0.4-0.8, and high if it produces a value above 0.8 (An Nabil et al., 2022).

The data obtained was then analyzed using the Aiken formula (1985) in Equation 1.

$$V = \frac{\Sigma S}{[n(C-1)]}$$
$$S = R - Lo \quad (1)$$

Notes:
V = Aiken Index
S = the score given by the rater
minus the lowest score in the category
R = the score given by the rater
Lo = lowest assessment score (1)
C = highest assessment score (4)
n = number of validators

After the learning process is complete, students are given a nutritional literacy test, administered individually. The nutritional literacy test, in essay form, consists of 10 questions, each aligned with four nutritional literacy indicators that correspond to science literacy indicators: content, context, process, and attitude. This adjustment was made because the primary focus of the research is to measure students' nutrition literacy, and the context of community service activities imposes time and scope limitations, necessitating an appropriate, targeted, and efficient instrument. The data obtained was then analyzed using Equation 2.

$$P = \frac{\text{score obtained}}{\text{maximum score}} \; x \; 100 \quad (2)$$

(Zebua et al., 2022)

Table 1 Nutrition literacy test scoring interpretation (Azzahra, 2024)

Value	Interpretation
80-100	Very good
70-79	Good
60-69	Simply
50-59	Less
0-49	Very Less

Note:
P = Percentage value

Based on the results, the data are then interpreted into the categories in Table 1.

3. RESULTS AND DISCUSSION

Validation of the research instruments obtained and the acquisition of students' nutritional literacy test scores will then be used as data for discussion and conclusions. Instrument validation in this study focuses on the nutritional literacy test to measure students' development of nutritional literacy. The validation sheet in this study uses science literacy indicators that refer to aspects of content, context, process, and attitude

3.1 Instrument Validation Results

Instrument validity in this study was used to determine whether the instruments used by researchers could measure what they were designed to measure. The validation of this research instrument was conducted from March 21 to April 21, 2025, by two lecturers, both experts in their fields, and one chemistry teacher. The instrument was validated to ensure that each item could specifically measure the impact of project-based learning — specifically, the activity of making pudding from moringa leaves — on students' nutritional literacy. Thus, the instrument used not only tested general nutrition knowledge but also reflected the learning outcomes achieved throughout the project. Data on the validation results of the resulting instrument are in Table 2.

The validity of the instrument was evaluated using a four-point scale, comprising the following categories: irrelevant (1), less relevant (2), quite relevant (3), and relevant (4). Expert validators assessed each item in the nutrition literacy test instrument based on these categories. The primary objective of this validation process was to ensure that each item accurately captured the established indicators of nutrition literacy —specifically, content, context, attitude, and process.

Each item on the nutrition literacy test instrument is assessed by expert validators based on these categories. The validation process aims to ensure that each item is truly capable of measuring aspects of nutrition literacy in accordance with the established indicators, namely content, context, attitude, and process. Questions measuring the content aspect include students' understanding of nutritional information and food composition; the context aspect is reflected in questions that relate nutritional

Tabel 2 Nutrition literacy test instrument validation results

No	Statement	Value V	V table value	Conclusion	Interpretation
1	Questions are in accordance with the indicators	0,89	0,75	Valid	High
2	Question are in accordance with the cognitive domain to be measured	0,78	0,75	Valid	Medium
3	Questions are easy to understand	1	0,75	Valid	High
4	The sentence in the question does not have a double meaning	0,78	0,75	Valid	Medium
5	The sentences used are clear and easy to understand	0,89	0,75	Valid	High
	Average	0,868	0,75	Valid	High

knowledge to daily life; and the attitude aspect is measured through questions that assess students' views and concerns about healthy eating patterns. In contrast, the process aspect includes questions that test the ability to think and make decisions based on nutritional information.

Based on the validation results presented in Table 2, an average score was obtained, indicating that most items were in the moderately relevant to relevant category. This indicates that the nutritional literacy test instrument used in this study has met the content validity criteria. In addition, the validators provided several constructive suggestions to improve the wording, clarity, and alignment with the nutritional literacy indicators. These suggestions served as a reference for revising and improving the instrument, making it more optimal for measuring students' nutritional literacy levels. Thus, it can be concluded that the validated nutritional literacy test instrument is valid and suitable for research, while continuing to address and implement the validators' suggestions to improve its overall quality.

3.2 Description of Learner Activities in Project-Based Learning on Making Pudding from Moringa (*Moringa oleifera*) Leaves

To develop a deep understanding of abstract scientific concepts, such as nutritional literacy and colloid properties, students need to engage in activities beyond simply reading and listening. In this context, project-based learning through the creation of pudding from moringa leaves provides students with hands-on experience observing colloid properties (such as the gelatinization process) while also understanding the material's nutritional content and health benefits. This active engagement enables students to build a stronger, more relevant conceptual understanding of real-world applications.

Learners need to find effective ways to develop their understanding, observe how classroom concepts are applied in real life, and reflect on this application. The learning process in this study has been adapted to the stages of project-based worksheets. This worksheet was developed independently by a researcher, based on project-based learning principles, and designed to facilitate students' understanding of colloid concepts while developing nutritional literacy. The worksheet was also developed based on project-based learning stages and adapted to real-life contexts to ensure relevance to students' experiences.

The stages of project-based learning include problem identification, making project designs, carrying out projects, compiling product drafts/prototypes, measuring, assessing, and improving products, and finalizing and publishing (Tazqiyah et al., 2021). Each stage not only promotes conceptual understanding among students but also integrates nutritional knowledge into real-life contexts. Through this process, students not only understand the importance of nutritious foods such as moringa pudding but are also trained to create publishable products that can be recommended to the public, such as posters. Publishing project results as posters encourages students to act as agents of change, creatively conveying nutritional information and thereby contributing to the development of nutritional literacy in their surrounding environment.

This study was conducted over three meetings. In meeting 1, the learning activities began with the opening. After conveying the material and the importance of nutritional literacy, students were divided into five groups to discuss further the worksheet on making pudding from moringa leaves (*Moringa oleifera*). The worksheet not only guides students technically through the process of making pudding but also encourages them to analyze relevant nutritional issues in their environment. Students are encouraged to identify the nutritional value of moringa leaves, consider their potential as a nutritious local food alternative, and evaluate the social and health benefits of the products they make. Thus, this worksheet provides students with space to engage in critical and reflective thinking about nutrition issues in their daily lives.

The learning process went smoothly, and meetings could be held until the project design stage. Then the learning ended, and the researcher briefed each group on how to make moringa leaf pudding at home. The materials needed include fresh moringa leaves obtained around the research site, plain agar flour, water, milk, and sugar. The procedure for making Moringa leaf pudding (*Moringa oleifera*) is the same as the procedure for making pudding in

general, except that Moringa leaves are added as a healthy and nutritious food additive.

Furthermore, at the second meeting, testing of the resulting pudding (product) was carried out. This is in accordance with the opinion expressed by Nugraheni (2018) This states that the final result of this learning is the product. Tests conducted in the school laboratory include organoleptic tests (favorability tests), pH tests, and biuret tests. An organoleptic test is one carried out using the senses as the primary tools. (Pardede et al., 2020) Such as the sense of smell (aroma), the sense of sight (color), the sense of taste (flavor), and the sense of touch (texture). Based on organoleptic tests of color, aroma, taste, and texture, most students did not like the smell of moringa leaves. Although the moringa leaf pudding is sweet, its green color is quite attractive, and its texture is soft and chewy, typical of pudding. However, not a few also like moringa pudding; this is because students have tried processed moringa leaves as a vegetable and think it is new. However, the organoleptic assessment in this study was descriptive and did not include quantitative data on the number of students who liked or disliked each sensory aspect. These findings were obtained based on general observations and group discussions. Therefore, further research is recommended to use a more structured sensory evaluation instrument to more precisely measure student preferences.

Furthermore, the pH test was performed to measure a product's acidity and basicity. The pH values obtained for each group are shown in Figure 1.

Figure 1 shows that the highest pH was observed in group 2 (7), and the lowest pH was observed in groups 1, 3, 4, and 5 (6). However, the difference was not significant because the variation in moringa leaf concentration did not affect the pudding's pH, which ranged from 6 to 7 and was categorized as neutral. This is in accordance with research conducted by Angraeni et al. (2025) This states that adding moringa leaf extract changes the pH only slightly, within a neutral range, so it does not affect the pudding's pH.

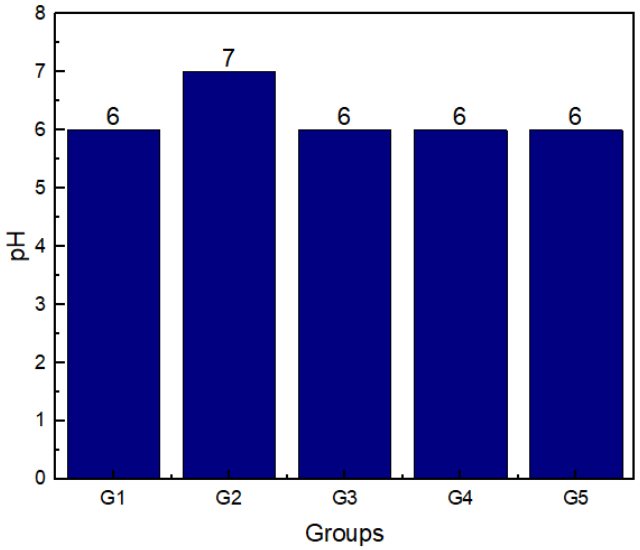

Figure 1 pH value of each group. Notes: G1 (5 g *Moringa oleifera* leaf extract), G2 (10 g *Moringa oleifera* leaf extract), G3 (15 g *Moringa oleifera* leaf extract), G4 (20 g *Moringa oleifera* leaf extract), G5 (25 g *Moringa oleifera* leaf extract).

Furthermore, the biuret test was performed to determine the protein content of the pudding. However, in the biuret test conducted to detect protein in moringa pudding products, the results showed variations between groups. Of the five groups that carried out the project, two — group 2 and group 4 — showed a slight purple color change in the pudding samples, while the other three groups did not show any significant color change. This phenomenon can be explained scientifically. The biuret test detects peptide bonds in proteins; when the biuret solution reacts with the protein, a purple color indicates a positive result. The process of cooking the pudding using high temperature for a certain amount of time can also cause protein denaturation (Priatni et al., 2020). If heating is too long or too hot, the protein can be damaged, so it no longer reacts optimally with the biuret solution. The different concentrations in each batch also affect this, so that the biuret solution does not clearly detect a protein content that is too low. The lower the protein concentration, the weaker the purple color. The learning process at the second meeting had progressed to measuring, assessing, and improving the product. At the end of the meeting, the researcher directed each group to prepare a practicum report as a poster.

In the third meeting, learning enters the finalization and publication stage, which is an important phase in project-based learning. This stage aims to provide learners with opportunities to reflect on the process they have gone through and to communicate their work to a broader audience. In this activity, each group is asked to compile and submit a scientific poster that contains complete information about the process of making moringa pudding, starting from the title of the experiment, experimental objectives, experimental principles, experimental tools and materials, experimental procedures, observation data, laboratory test results (organoleptic, pH, and biuret tests), to the conclusions they get.

The posters are then presented to the class. This activity is designed to resemble a simple scientific presentation, helping students get used to systematically and scientifically communicating ideas, data, and project results. The participants' enthusiasm was very evident at this stage. This can be seen in their earnestness in preparing attractive poster designs, the equal distribution of presentation tasks, and the active involvement of all group members. Each group performed confidently, presented their findings, and provided explanations to the audience. Examples of posters created are shown in Figure 2.

Figure 2 Examples of posters that have been create.

The presentation session was followed by a discussion and question-and-answer session, where students asked each other questions, received responses, and even offered suggestions on other groups' projects. The class atmosphere became very interactive and communicative. Students not only demonstrated their public speaking skills but also showed mutual respect, active listening, and critical thinking in their responses to their friends' presentations. Through this activity, students not only learn science and nutrition, but also develop scientific communication skills, collaboration, and responsibility for their group's work.

In addition to classroom presentations, this activity aims to provide broader benefits beyond the school environment. Therefore, the project results in the form of moringa leaf pudding are expected to be used in community service activities through collaboration with the Integrated Health Service Post (*Posyandu*) in the school's surrounding area. Through this approach, students not only develop scientific and collaborative skills but also make a real contribution to delivering nutrition education to the community. This activity is part of the expanded publication phase of project-based learning, in line with the principle that student projects should ideally have a relevant social impact.

3.3 Nutrition Literacy Test Results

The results of this study indicate that project-based learning in making pudding from *Moringa oleifera* leaves can improve students' overall nutritional literacy. After implementing project-based learning, it is important to evaluate students' potential, namely their nutritional literacy. Nutritional literacy is a person's ability to obtain, understand, and apply nutrition information to achieve a healthy lifestyle. The literacy measurement in this study refers to science literacy indicators, including content (students' nutritional knowledge), context (application in daily life), attitude (awareness of and value for nutrition), and process (ability to think critically and analytically about nutritional information). Thus, the nutritional literacy test aims to measure the extent to which students can understand and apply nutritional concepts thoroughly, in accordance with these indicators. The results of the nutritional literacy test assessment are presented in Table 3.

This learning approach, which integrates scientific aspects and ethical values, aligns with the goal of holistic education: to form people who are not only intellectually intelligent but also possess noble character and social responsibility. Thus, the development of nutritional literacy through project-based learning not only improves the quality of life of individual learners but also contributes to the creation of a healthy, sustainable, and compassionate society—a concrete manifestation of the application of *rahmatan lil alamin* in the context of education and health. The results of the learners' nutritional literacy test are also presented in Figure 3.

Based on this data, the results of the students' nutritional literacy test based on four leading indicators, namely content, context, process, and attitude, were measured through several questions with a level of depth of thinking that led to an understanding of nutrition, particularly in relation to moringa leaves (*Moringa oleifera*). In the early stages of project-based learning, students were involved in problem identification and project design activities, exploring issues related to low nutrition literacy and the use of moringa leaves as a local source of nutrition. These activities encouraged students to explore factual and

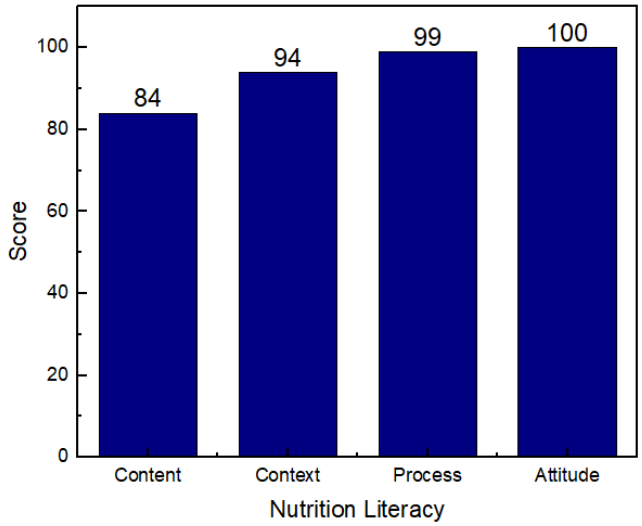

Figure 3 Learner nutrition literacy test results.

conceptual information about nutrients and the benefits of moringa leaves. The average score for the content indicator was 84, which is categorized as very good. These results indicate that students not only understand the theory but also connect concepts to real-life practices in their daily lives. Students demonstrated strong ability to classify nutrients, such as carbohydrates, proteins, vitamins, and minerals, and could explain the functions of each nutrient for health. Additionally, they can analyze experimental results, such as changes in color in moringa pudding, and relate them to protein content. This indicates that students can understand nutritional information from texts, images, and practical results. This initial activity directly contributes to the development of a strong foundation in nutritional literacy.

During the project implementation stage, including the production and processing of moringa leaf pudding, students were allowed to relate nutritional information to real life, such as understanding the impact of diet on health and the application of nutritious food consumption in daily life. They not only learned about the benefits of moringa leaves but also saw firsthand how it was processed into healthy food products. In terms of context, students achieved an average score of 94 with excellent interpretation. This indicates that students have a strong understanding of how to link nutritional concepts to real-world conditions. The questions in this indicator encourage students to identify the nutritional benefits of moringa leaves for the human body, analyze the long-term effects of unhealthy eating patterns, and explain the contribution of moringa leaves to health when consumed in food products such as pudding.

Students demonstrated a good understanding of the importance of consuming nutritious foods and their impact on long-term health. They were able to relate nutritional information to their daily eating habits and showed awareness of the importance of choosing nutritious local foods, such as moringa leaves. These results reinforce the evidence that project-based learning approaches are practical in building students' understanding in real-life contexts. Additionally, using moringa leaves as the main

Table 3 Student nutrition literacy test scores

Indicator	Question	Question No	Average Value
Content	Based on the discourse, identify the ingredients used based on the nutrition classification!	1	84
	Based on the nutritional content, which food is better to choose? Explain your reasons for choosing the food!	6	
	Based on the picture above, which activities can be done to get used to healthy living behavior?	8	
	Based on the test results, what color changes occur? Explain why the color change in moringa pudding indicates the presence of protein!	10	
Context	Based on this information, identify the role of each nutrient contained in Moringa leaves on the health of the human body!	2	94
	Based on this information, analyze the nutritional content of moringa leaves and explain how these nutrients contribute to health benefits when consumed in pudding form!	3	
	Based on the discourse, analyze the impact that will occur if Raka's diet is carried out for a long period of time?	4	
Process	Based on the discourse, analyze how to manage a healthy evening meal in order to support a balanced diet and prevent disease risk!	5	99
	Based on this information, explain the steps you can take to keep the nutritional content of moringa pudding optimal, and how this supports a healthy lifestyle in your daily life!	7	
Attitude	Based on the picture above, which activities can be done to get used to healthy living behavior?	9	100
Average			94

ingredient in the product encourages students to recognize the potential of local food as an affordable, readily accessible, and nutrient-rich source. Students not only learn about its nutritional content but also gain insights into food security, sustainability, and local consumption culture, thereby expanding their understanding not only theoretically but also practically and contextually.

During the measuring, evaluating, and improving stage of the product, students test the pudding they have made using organoleptic tests, pH tests, and biuret tests. This activity requires students to apply scientific thinking skills, such as observing, analyzing data, predicting, and drawing conclusions from direct observations. The average student score on the process indicator is 99, indicating excellent performance. The process indicator in nutrition literacy measures students' ability to think critically and analyze nutritional information obtained from various sources, both written and from direct practical experience. This indicates that they possess excellent analytical and applied skills. The score reflects that students not only understand nutritional theory but can also apply it in practice. For example, students can explain in detail how to maintain the nutritional content of moringa leaf pudding throughout preparation and serving, and relate this to the importance of a healthy daily lifestyle.

This success can be attributed to the implementation of a project-based learning model that provides students with direct and contextual learning experiences. Through the practical activity of making moringa pudding, students are trained to observe, predict, analyze, and draw conclusions from directly obtained data. This approach not only improves critical and analytical thinking skills but also strengthens decision-making abilities based on empirical evidence. Thus, project-based learning has proven effective in developing students' scientific process skills, which are an important aspect of nutrition literacy and of science education in general.

Additionally, the high scores on the process indicators indicate that students can harmoniously integrate theoretical knowledge with real-world practice, resulting in a deeper, more meaningful understanding. This aligns with the principles of constructivism, which emphasize active learning and direct experience in developing conceptual understanding. Therefore, these results reinforce the argument that project-based learning not only develops content mastery but also cultivates higher-order thinking skills essential for addressing real-world challenges, particularly in the context of health and nutrition.

Attitude indicators in nutrition literacy focus on measuring students' awareness, values, and commitment to applying healthy behaviors in their daily lives. In this study, students achieved a very high average score of 100, indicating an extraordinary level of awareness and positive attitude toward the importance of healthy living. These results indicate that students not only understand theoretical concepts in nutrition and health but also internalize these values, as reflected in their attitudes and behaviors. Furthermore, students can identify various activities that support the adoption of healthy lifestyle behaviors, such as choosing nutritious foods, maintaining hygiene, and engaging in regular physical activity. This ability demonstrates that the applied learning has successfully built students' critical awareness and personal responsibility in maintaining their health. This positive attitude is an important foundation for forming sustainable, healthy habits, which, in turn, can improve quality of life and help prevent future health problems.

Achieving a perfect score on the attitude indicator also confirms the effectiveness of the project-based learning model in instilling holistic health values. Through contextual and relevant learning experiences, students not only gain knowledge but are also guided to develop proactive attitudes and a genuine commitment to a healthy lifestyle. Thus, these results reinforce the role of project-based learning as an educational strategy that integrates cognitive and affective aspects in the development of nutritional literacy, while preparing students to become aware and responsible individuals for their personal health and the environment around them.

The results of this study not only demonstrate the success of project-based learning in improving nutrition literacy across cognitive, affective, and scientific process skills but also reflect humanistic values aligned with the principle of *rahmatan lil alamin*. The concept of "*rahmatan lil alamin*," meaning mercy for all of creation, emphasizes the importance of maintaining balance and sustainability in life, including in health and the wise use of food resources. By instilling awareness of healthy lifestyles and the utilization of nutritious local foods such as moringa leaves, this learning process also educates students to become agents of change who care not only about their own health but also about the environment and society at large.

This educational approach, which integrates scientific aspects and ethical values, aligns with the holistic goals of education, which aim to cultivate individuals who are not only intellectually intelligent but also morally upright and socially responsible. Thus, the development of nutritional literacy through project-based learning not only improves the quality of life of students individually but also contributes to the creation of a healthy, sustainable, and compassionate society—a tangible manifestation of the application of "*rahmatan lil alamin*" in the context of education and health.

Overall, the results of the nutrition literacy assessment indicate excellent achievement among students. This can be further elaborated as follows: the average test score measuring students' nutrition literacy is 94, which falls into the "outstanding" category. Students' nutrition literacy is generally strong, with the highest scores observed in the

attitude (100) and process (99) aspects. The Context aspect also scores high (94), while the Content aspect scores lowest (84), suggesting a need to enhance students' understanding of basic nutrition concepts. This learning is not only aimed at improving students' nutrition literacy but is also expected to provide direct benefits to the community. During implementation, students are encouraged to share the knowledge they have gained with family members and the surrounding community, for example, through simple presentations, group discussions, or by distributing the product results in the form of moringa leaf pudding. Additionally, the product developed in this project is moringa leaf.

4. CONCLUSION

Based on the research results, implementing project-based learning in making pudding from moringa leaves (Moringa oleifera) has been proven to holistically develop students' nutritional literacy, covering content, context, process, and attitude. In addition to promoting mastery of nutritional concepts and scientific skills, this is in line with the value of *rahmatan lil 'alamin*, namely that Islam, as a mercy for all nature, encourages humanity to maintain health, love the environment, utilize natural resources wisely, and contribute positively to social life. The project not only provides meaningful learning experiences for students but also has the potential to make a tangible contribution to society through nutrition education and the utilization of local food resources. Thus, project-based learning is an effective strategy for integrating knowledge, skills, attitudes, and values within the context of transformative science education.

REFERENCES

Agustina, T., Rudi, L., & Faahyuddin. (2025). Penerapan model pembelajaran project based learning pada materi koloid untuk meningkatkan hasil belajar siswa [Application of the project based learning model on colloid material to improve student learning outcomes]. *Jurnal Pendidikan Kimia, 10*(1), 59–75. doi:10.36709/jpkim.v10i1.72

Amalia, S. N. I., Octaria, Y. C., Maryusman, T., & Imrar, I. F. (2023). Associations between social media use and eating behavior, physical activity, and nutritional status among adolescents in DKI Jakarta. *Amerta Nutrition, 7*(2SP), 193–198. doi:10.20473/amnt.v7i2SP.2023.193-198

An Nabil, N. R., Wulandari, I., Yamtinah, S., Ariani, S. R. D., & Ulfa, M. (2022). Analisis indeks Aiken untuk mengetahui validitas isi instrumen asesmen kompetensi minimum berbasis konteks sains kimia [Aiken index analysis to determine the content validity of the minimum competency assessment instrument based on a chemical science context]. *Paedagogia, 25*(2), 184. doi:10.20961/paedagogia.v25i2.64566

Angraeni, L., Elfika, F., Rahmi, S., Husin, H., & Anggriawin, M. (2025). Chemical analysis and organoleptic characteristics of pudding with the addition of moringa leaf extract and red bean milk. *Edufortech, 10*(1), 62–77. doi:10.17509/edufortech.v10i1

Aulia, N. R. (2021). Peran pengetahuan gizi terhadap asupan energi, status gizi dan sikap tentang gizi remaja [The role of nutritional knowledge on energy intake, nutritional status, and attitudes about adolescent nutrition]. *Jurnal Ilmiah Gizi Dan Kesehatan (JIGK), 2*(2), 31–35. doi:10.46772/jigk.v2i02.454

Azzahra, R. (2024). *Penerapan pembelajaran berbasis proyek pada pembuatan fruitghurt dari kulit buah untuk mengembangkan literasi nutrisi* [Application of project-based learning in the making of Fruitghurt from fruit peels to develop nutritional literacy] (Skripsi tidak dipublikasikan). UIN Bandung, Indonesia. Diperoleh dari https://digilib.uinsgd.ac.id/id/eprint/97328

Denniss, E., Lindberg, R., & McNaughton, S. A. (2023). Quality and accuracy of online nutrition-related information: a systematic review of content analysis studies. *Public Health Nutrition, 26*(7), 1345–1357. doi:10.1017/S1368980023000873

Eckardt, P. N., Craig, M., & Kraemer, L. (2020). The impact of project-based learning on student content knowledge in an undergraduate, teacher preparation, foundations of education course. *Journal for Leadership and Instruction, 19*(1), 38–42. Diperoleh dari https://files.eric.ed.gov/fulltext/EJ1255862.pdf

Fitri, R., Lufri, L., Alberida, H., Amran, A., & Fachry, R. (2024). The project-based learning model and its contribution to student creativity: A review. *JPBI (Jurnal Pendidikan Biologi Indonesia), 10*(1), 223–233. doi:10.22219/jpbi.v10i1.31499

Gibbs, H. D., Kennett, A. R., Kerling, E. H., Yu, Q., Gajewski, B., Ptomey, L. T., & Sullivan, D. K. (2016). Assessing the nutrition literacy of parents and its relationship with child diet quality. *Journal of Nutrition Education and Behavior, 48*(7), 505-509.e1. doi:10.1016/j.jneb.2016.04.006

Herawati, H. (2018). Potensi hidrokoloid sebagai bahan tambahan pada produk pangan dan nonpangan bermutu [The potential of hydrocolloids as additives in quality food and non-food products]. *Jurnal Penelitian Dan Pengembangan Pertanian, 37*(1), 17–25. doi:10.21082/jp3.v37n1.2018.p17-25

Islam, Z., Islam, S. M. R., Hossen, F., Mahtab-Ul-Islam, K., Hasan, M. R., & Karim, R. (2021). Moringa oleifera is a prominent source of nutrients with potential health benefits. *International Journal of Food Science, 2021*, 1–11. doi:10.1155/2021/6627265

Lestarini, P. A., Yuniarti, L. N. L., Sudiarta, I. K., Lestari, M. P. L., & Agustina, K. S. (2024). Pencegahan stunting melalui edukasi pada masyarakat di Desa Cepaka Kecamatan Kediri Kabupaten Tabanan Bali [Stunting prevention through education for the community in Cepaka Village, Kediri District, Tabanan Regency, Bali]. *Jurnal Sinergi Kesehatan Indonesia, 2*(1), 1–9. doi:10.55887/jski.v2i1.18

Mansfield, E., Wahba, R., & De Grandpré, E. (2020). Integrating a health literacy lens into nutrition labelling policy in Canada. *International Journal of Environmental Research and Public Health, 17*(11), 1–7. doi:10.3390/ijerph17114130

Marfu'ah, S., & Meristin, A. (2022). Lembar kerja laboratorium berbasis proyek pembuatan koloid dengan pemanfaatan daun cincau perdu (Premna oblongifolia) [Project-based laboratory worksheet for making colloids by utilizing shrub grass jelly (Premna oblongifolia) leaves]. *Orbital: Jurnal Pendidikan Kimia, 6*(2), 160–170. doi:10.19109/ojpk.v6i2.15015

Nomleni, F. T., Boimau, H., & Bullu, N. I. (2024). Penggunaan lkpd berbasis proyek terhadap hasil belajar siswa SMP Negeri 3 Amanuban Tengah [The use of project-based student worksheets on the learning outcomes of students at SMP Negeri 3 Amanuban Tengah]. *Indigenous, 7*(2), 28–33. doi:10.33323/indigenous.v7i2.593

Nugraheni, D. (2018). Pembelajaran berbasis proyek (project based learning) materi kalor dan perpindahannya untuk meningkatkan kreativitas siswa [Project based learning on heat and its transfer to improve student creativity]. *Jurnal Penelitian Pembelajaran Fisika, 9*(2). doi:10.26877/jp2f.v9i2.2798

Nursiah, A. (2024). The role of digital technology in improving nutrition education for millennials and Generation Z. *Nutrizione, 1*(3), 11–20. Diperoleh dari [tautan mencurigakan telah dihapus]

Pardede, D. E., Febrianti, D., & Putri, R. M. S. (2020). Karakteristik organoleptik flavor alami dari kaldu kepala ikan tongkol (Euthynnus affinis) [Organoleptic characteristics of natural flavor

from tuna (Euthynnus affinis) head broth]. *Jurnal Teknologi Pertanian, 9*(2), 43–52.

Parera, L. A. M., Toni, S., Naat, J., Sudirman, S., Dewi, N. W. O., Kerihi, E. C. G., & Nenohai, J. A. (2022). Pengembangan video pembelajaran kimia berbantuan kinemaster pada materi sistem koloid untuk kelas XI SMA/MA [Development of kinemaster-assisted chemistry learning videos on the colloid system material for class XI SMA/MA]. *Jurnal Beta Kimia, 2*(1), 23–32. doi:10.35508/jbk.v2i1.7247

Pradita, L. S., Rakhma, L. R., & Widiyaningsih, E. N. (2023). Perbedaan tingkat literasi gizi dan status gizi pada siswa sekolah kesehatan dan non kesehatan di Surakarta [Differences in nutrition literacy levels and nutritional status in health and non-health school students in Surakarta]. *Health Information : Jurnal Penelitian, 15*(2), 1–11. Diperoleh dari https://myjurnal.poltekkes-kdi.ac.id/index.php/hijp/article/view/1241

Priatni, H. L., Kurniasari, N., & Wiryani, A. S. (2020). Identifikasi asam amino dan protein pada bahan makanan dengan menggunakan uji ninhidrin dan uji biuret [Identification of amino acids and proteins in food ingredients using the ninhydrin test and biuret test]. *Sains Indonesiana: Jurnal Ilmiah Nusantara, 1*(5), 20-23.

Quinapallo-quintana, A. M., & Quinapallo-quintana, A. M. (2024). Project-based learning. *[Nama Jurnal tidak tersedia], 11*(1), 58–65.

Ramadhan, E. H., & Hindun. (2023). Penerapan model pembelajaran berbasis proyek untuk membantu siswa berpikir kreatif [Application of a project-based learning model to help students think creatively]. *Protasis: Jurnal Bahasa, Sastra, Budaya, Dan Pengajarannya, 2*(2), 43–54. doi:10.55606/protasis.v2i2.98

Ratminingsih, N. M. (2017). Penelitian eksperimental dalam pembelajaran bahasa kedua [Experimental research in second language learning]. *Prasi, 6*(11), 31–40. Diperoleh dari https://ejournal.undiksha.ac.id/index.php/PRASI/article/view/6816

Srimiati, M., Habibah, P., Dinya Zahra, A., Harsanti, F., & Ratu Maharani, A. R. (2023). Effect of strawberry powder substitution on the organoleptic properties of instant pudding. *Media Gizi Indonesia, 18*(1), 74–81. doi:10.20473/mgi.v18i1.74-81

Sugiyono. (2015). *Metode penelitian pendidikan*. Bandung: Alfabeta.

Tazqiyah, R. Z., Windayani, N., & Helsy, I. (2021). Pengembangan lembar kerja berbasis proyek pada pemanfaatan limbah biji kurma terfermentasi sebagai bahan baku minuman date coffee [Development of project based worksheets on the utilization of fermented date seeds waste as a raw material for date coffee drinks]. *Gunung Djati Conference Series, 2*, 315–327. Diperoleh dari http://download.garuda.kemdikbud.go.id/article.php?article=3355077&val=29417