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Development of the P5 Module for Hydroponic Pakcoy Cultivation Based on Bioentrepreneurship in Developing Students' Independence Character and Science Process Skills

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Abstract: This study aimed to develop a Strengthening Pancasila Student Profile (P5) module on hydroponic pakcoy cultivation based on bioentrepreneurship as a learning medium to foster independence and scientific skills among eighth-grade students at SMP Negeri 4 Loa Janan. The research employed a Research and Development (R&D) design following the ADDIE model, which consists of the stages of Analysis, Design, Development, Implementation, and Evaluation. Data were collected through observations, expert validation questionnaires, and limited student trials. The results indicated that the developed module was highly feasible, as evidenced by expert validation scores from material experts, media experts, and practitioners, all categorized as "very good." The implementation results showed that the module effectively enhanced students' independence through hydroponic cultivation activities and improved their scientific skills through observation, experimentation, and plant growth analysis. The integration of bioentrepreneurship elements provided meaningful and contextual learning experiences that connected science with real-world entrepreneurial opportunities. In conclusion, the bioentrepreneurship-based P5 module was effective and feasible as a learning medium to strengthen students' academic competence, independence, and 21st-century skills.

Keywords: Bioentrepreneurship; Hydroponics; Independence; P5 module; Pakcoy cultivation; Scientific skills

Introduction

Education plays a crucial role in the nation's development process. It is a process of transforming individuals into individuals of higher quality and greater utility. Changes in attitudes, mindsets, and perspectives on life need to be taught (Sari et al., 2025). The goal of education is not merely the transfer of knowledge but also the development of professional character in line with the demands of the times. Education also aims to build students' character and skills to face the challenges of today's globalization era (Barokah et al., 2025). Education is a process through which learners develop their affective, cognitive, and psychomotor competencies (Elisa et al., 2022). Individuals in every country have the opportunity to receive a decent and quality education. This goal is supported by the belief that each individual possesses different abilities and creativity, enabling these abilities to be developed and made more meaningful. Government efforts to support education, particularly in the face of the current industrial revolution 4.0, are highly dependent on the role of government policies as strategic steps to address the impacts of change and improve the quality of human resources in this era.

Many factors support educational improvement, such as curriculum factors, educational policies,

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technology use, resources, and so on. Curriculum changes and developments play a crucial role in improving the quality of learning, as the curriculum is considered the core of education, determining the continuity of the educational process. The government has implemented the Independent Curriculum as a learning plan aimed at providing students with opportunities to learn independently and enjoyably, without pressure, and in a calm atmosphere, so that each student can demonstrate their potential and grow into lifelong learners with character as the profile of Pancasila students (Alfatia et al., 2025). The Independent Curriculum is designed with a learning structure that emphasizes resource utilization and the development of student character and skills (Asriani et al., 2024). The Independent Curriculum is a curriculum that focuses on various intracurricular learning activities to optimize conceptual understanding and strengthen student competencies (Karlina & Hindriana, 2023). In the independent curriculum, students are required to create projects that can develop their potential, knowledge, and skills in various fields (Tofa, 2024).

The implementation of the independent curriculum requires students to have the ability to design projects with the aim of developing their potential and skills in various fields. One part of the implementation of the independent curriculum is the Pancasila Student Profile Strengthening Project (P5). P5 is a program that prioritizes the spirit of independence and creativity to improve individual skills and strengthen students' character. This P5 is carried out to train students to recognize real problems in their surroundings (Silviana et al., 2024). The Pancasila Student Profile Strengthening Project is a form of out-of-class learning that serves to complement intracurricular learning while also strengthening efforts to achieve competencies and develop character in accordance with the Pancasila student profile based on Pancasila values (Hulalata et al., 2025; Soraya et al., 2025).

P5 is a new learning model introduced in pioneering schools. The 2022/2023 academic year marks the beginning of the implementation of the Independent Curriculum, which also implements P5. The implementation of the Independent Curriculum, introduced in 2022, emphasizes the strengthening of Pancasila ideology in education through the Strengthening of the Pancasila Project Student Profile (P5) (Jefri & Marzuki, 2025). P5 is implemented by students at various school levels. P5 aims to shape students with personalities and skills in accordance with Pancasila values (Fithriyah et al., 2025). P5 aims to create students who are morally upright, critical thinkers, creative, independent, and able to collaborate in diverse settings. P5 is an educational innovation designed to meet the needs of 21st-century learning (Rori et al., 2025). P5 also emphasizes the need for students to understand and practice the concepts contained in the Pancasila Learning Profile. Implementation of P5 activities can foster students' self-confidence in their work, can enhance students' potential, and can identify students' interests and talents in certain fields. In its implementation, teachers play a crucial role as facilitators (Saraswati et al., 2022).

Given the numerous benefits of P5, both for educators and students, it is crucial to implement it in schools across Indonesia, including in Kutai Kartanegara Regency. Several schools, particularly junior high schools in Kutai Kartanegara Regency, have implemented the Strengthening of the Pancasila Student Profile Project (P5). Some of the themes frequently used in P5 include sustainable lifestyles, local wisdom, Bhinneka Tunggal Ika (Unity in Diversity), entrepreneurship, and the theme of Engineering and Technology to Build the Unitary State of the Republic of Indonesia (NKRI). Among the many schools, particularly public junior high schools in Kutai Kartanegara Regency, one implementing P5 is SMP Negeri 4 Loa Janan Samarinda. The Strengthening of the Pancasila Student Profile Project provides opportunities for students to learn in a non-formal context through flexible learning structures, interactive activities, and direct connections to their surroundings (Julaidar et al., 2024).

SMP Negeri 4 Loa Janan is one of the Public Schools in Kutai Kartanegara Regency, located at Jl. Padat Karya RT 8 Loa Duri, Loa Duri Ulu, Loa Janan District, Kutai Kartanegara Regency, East Kalimantan 75391. SMP Negeri 4 Loa Janan started its educational and teaching activities in 2008. SMP Negeri 4 Loa Janan under the leadership of Mr. Nur Alim, S.Ag., M.Pd. SMP Negeri 4 Loa Janan has also received school status with grade B accreditation from BAN-S/M (National Accreditation Board) of Schools/Madrasas. The strategic condition of the school area is surrounded by trees and various large plants such as oil palm and Ketapang, while for vegetable plants it is less fertile if planted in the ground because the soil texture is less fertile and contains a lot of coal. Some extracurricular activities of students are often practiced by planting plants or herbs and vegetables not directly in the ground but in pots or polybags.

Therefore, the school's efforts in integrating practical learning and skill development for students, especially in fostering the character of independence of students at SMP Negeri 4 Loa Janan, need to apply scientific knowledge with the theme of Sustainable Lifestyle, especially the cultivation of Hydroponic vegetables. The need for this activity is because so far students do not understand the hydroponic planting system, students are more given material without direct

practice in the field. For this reason, the purpose of this activity is to provide understanding and foster the character of independence for students through how to plant vegetables, so that hydroponic mustard greens are introduced, another goal is to be able to learn how to care for plants so that they are more effective while supporting students' social attitudes to care for the beauty and sustainability of the environment.

The selection of pak choy (Brassica Rapa L.) as a P5 Project for SMP Negeri 4 Loa Janan is because mustard greens are a suitable medium for hydroponic cultivation, and these vegetable plants are easy to grow and develop in the Kutai Kartanegara area, making it easier for students to carry out planting activities outside of school hours. Pak choy mustard greens were chosen because they can be done through hydroponic methods, and the harvest period of pak choy mustard greens can be shortened to around ± 45 days or 4 weeks, so they are suitable for projects at school (Rahma et al., 2024).

In addition to being an innovative learning media that is in accordance with P5, a bioentrepreneurship-based P5 module was developed. The creation of modules or learning media is one way to support the success of the Independent Curriculum. The development of the P5 module aims to help teachers and students understand the flow and materials used in P5 activities (Rori et al., 2025). By using the P5 module, students are expected to be trained in understanding the material and have science process skills. The need to implement the P5 module, especially the theme of sustainable lifestyle in bioentrepreneurship-based hydroponic vegetable cultivation, not only increases science process skills but also fosters the independent character of students at SMP Negeri 4 Loa Janan. An independent character is very much needed by students because with this character, students are expected to be able to solve environmental problems independently (Fauziah et al., 2024). On the other hand, P5 must be included in the module and must be tailored to the needs of students, educators, and schools (Nugraheni et al., 2024).

Efforts to develop character building for students to be more independent, the theme of Sustainable Lifestyle is more suitable to be applied in the P5 module, especially students' understanding of hydroponic vegetable plants, so that later students will be able to find scientific knowledge concepts that suit their expertise, and most importantly, help students in developing their independent character. Interesting learning materials can motivate students to learn independently outside the classroom so that the learning process will continue until students can master the material presented.

Based on the description of the background and the phenomenon, this study aims to develop the P5 Module for Hydroponic Pakcoy Mustard Cultivation Based on Bioentrepreneurship in Developing the Character of Independence and Science Skills of Class VIII Students of SMP Negeri 4 Loa Janan.

Method

The research conducted is a type of Research and Development (R&D). The model used in this study is the ADDIE development model, which consists of Analysis, Design, Development, Implementation, and Evaluation (Figure 1). The development research conducted was to develop a product in the form of a P5 module as a science learning resource. This development research was conducted at SMP Negeri 4 Loa Janan.

Figure 1. Stages of the ADDIE model (Aldoobie, 2015)

The subjects of the development research were 32 students of class VIII (eight) of SMP Negeri 4 Loa Janan, Kutai Kartanegara Regency, East Kalimantan Province. The research instruments used were the P5 module evaluation questionnaire and observation sheets. The analysis technique in this development research used qualitative descriptive analysis techniques.

Result and Discussion

This research is a developmental study that produces a new innovative product, namely the bioentrepreneurship-based P5 module using the ADDIE development model. This research was conducted on 32 students in class VIII A.

The P5 module was developed through several stages, namely the first stage of analyzing student needs through direct observation and interviews with the principal, deputy curriculum, deputy student affairs, TAS, science subject teachers, and students; the second stage of creating a product design for the P5 module to be developed; the third stage of developing a product in the form of a P5 module using the Canva application and then conducting a product validity test with a predetermined expert validator; and the fourth stage

After the P5 Module was declared valid by the expert validator, the product in the form of the P5 Module was then implemented in a small class, namely the Science Class Extracurricular students, to find out the practicality of the product, and the fifth stage was evaluation to determine the effectiveness of the product that had been made through pretest and posttest assessments of students.

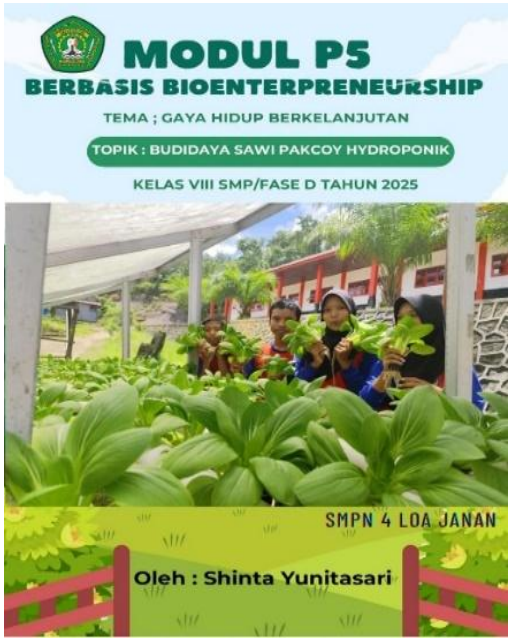

Figure 4. Front Cover of Module P5

Figure 2 is the cover of Module P5, which has been developed and tested directly in class VIII of SMP Negeri 4 Loa Janan on the topic of hydroponic pakcoy mustard cultivation for the sustainable lifestyle theme.

Validation of Module P5 was conducted by expert validators with relevant backgrounds to ensure accurate assessments. The validity results of Module P5 are shown in the table below.

Table 1. P5 Module Validation Results

Validator	Score (%)	Criteria
Media	91.7	Very Valid
Material	94.1	Very Valid

Next, a practicality test was conducted by administering a questionnaire to several respondents to assess module P5. The practicality results are presented in the following table.

Table 2. Results of the Teacher and Student Response Questionnaire

Respondent	Assessment Score	Score Maximum	Percentage
Teacher I	42	44	95%
Teacher II	40	44	91%
Category			Very Practical
Small class students	364	400	91%
Large class students	1.191	1.280	93%
Category			Very Practical

Next, an independent t-test and an N-Gain test were conducted to determine the effectiveness of the P5 module in improving independent learning and science process skills. The results of the effectiveness test can be seen in the following table.

Table 3. Results of the Independent Sample t-Test

		Levene's Test for Equality of Variances		t-test for Equality of Mean		
		F	Sig.	t	df	Sig. (2-tailed
Learning outcomes	Equal variances assumed	2.452	.122	-10.306	62	.00
	Equal variances not assumed			-10.306	58.870	.00

Based on Table 3, the results of the independent sample T-test obtained a sig. (2-tailed) value ≤ 0.05, indicating a significant difference in the student's KPS using the bioentrepreneurship-based P5 Module.

Next, an N-Gain Test was conducted to determine the extent of the development of KPS and student independence before and after treatment with the P5 Module. The results of the N-Gain Test data can be seen in the table 4.

Table 4. N-Gain Test Results

Class Type		Descriptive Statistic			
		N	Minimum	Maximum	Mea
Control	Ngain_Score	32	.34	.75	.566
	Ngain_Percen	32	34.38	75.00	56.62
Experimental	Ngain_Score	32	.55	.89	.755
	Ngain_Percen	32	54.55	89.06	75.55

The effectiveness test of the developed P5 Module was analyzed using the N-Gain Test and the independent t-test. The results of the Pre-test and Post-test became the basis for measuring the effectiveness test

based on indicators of independence and students' science process skills, namely observing, asking questions, collecting information, classifying, measuring, predicting, interpreting data, formulating hypotheses, planning experiments, applying concepts, and communicating.

Based on the results of the hypothesis test with an independent t-test and an obtained t-test significance value of 0.000 < 0.05, there is a significant difference between the independence and science skills of the control and experimental classes. Based on the N-Gain score category in Table 4, an N-Gain value of 0.75 was obtained for the experimental class with a high improvement category. The results of this study prove that the use of modules in the learning process can improve students' abilities in fostering independence and science process skills. This is in accordance with what is written by Istianah et al. (2021) that in order to create students with Pancasila character who successfully complete academic programs, the Pancasila education system has implemented a number of projects related to character values. These projects include acculturation and adjustments related to projects related to these character values, with the hope of developing students who have ethical and moral standards in line with the Pancasila ideology.

Conclusion

Based on the research objectives outlined in the previous chapter and the field research conducted, it can be concluded that the P5 module was developed through interviews and direct observations with senior teachers using the ADDIE model, which includes five stages: Analysis, Design, Development, Implementation, and Evaluation. The validity level of the bioentrepreneurship-based P5 module, as assessed by experts, showed excellent results, with the material expert validator obtaining a score of 94.1% and the media expert validator obtaining a score of 91.7%, both categorized as very valid. The practicality level of the module, based on user responses, was also high, with students scoring 92% and teachers 93%, both in the very practical category. Furthermore, the module's effectiveness, as measured by students' pretest and posttest results using the Sample T-Test and N-Gain test, showed an N-Gain score of 0.75 (≥ 0.7), indicating that the bioentrepreneurship-based P5 module on hydroponic pakcoy cultivation is effective in fostering student independence and scientific skills.

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Author Contributions
S.Y.; A.H.; A.; U.; E.P.; E.T.M.: conceptualized the research, research procedures, analyzed the data and wrote the article; F.I.: supervised the writing of the article, reviewed and validated the research instruments used.

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Conflicts of Interest
The authors declare no conflict of interest.

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