

# Validity and practicality of project-based learning teaching modules to train life skills Era Society 5.0 (bioentrepreneurship)

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**Abstract:** In the 21st century, Indonesian education must generate life skills for dealing with the era of society 5.0. Bioentrepreneurship skills are one of those needed to achieve the primary goal of society 5.0. However, teaching modules that combine entrepreneurship skills still need to be improved. This research aims to produce project-based learning teaching modules on plant growth and development material to train valid and practical society 5.0 (bioentrepreneurship) era skills. This research used a 4D. The teaching module's validity was determined by the validation results of three experienced lecturers. The practicality of the teaching module was measured based on the results of the readability test. The results of the teaching module validity test obtained an average score of 3.8, which is very valid. The results of the practicality test are reviewed from the textbook readability test, which is categorized as level 12 with a practical category. The results showed that project-based learning teaching modules on plant growth and development material are valid and practical to train the skills of the era of society 5.0 (bioentrepreneurship). Society era 5.0 (bioentrepreneurship) skills students can be trained by integrating plant growth and development biology material with microgreens cultivation project activities in project-based learning modules.

**Keywords:** bioentrepreneurship; plant growth and development; project-based learning; teaching module

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## Introduction

The 21st-century education in Indonesia prepares human resources (HR) who have life and career skills, learning and innovation skills, and information media and technology skills (Sukmayadi & Yahya, 2020). Educational institutions have the responsibility to produce competent graduates and superior human resources to be ready to face the revolution of society era 5.0. Through the learning process, students are not only equipped with theoretical knowledge but also facilitated with life skills (Geertshuis *et al.*, 2022; Karim *et al.*, 2012; Togo & Gandidzanwa, 2021). Life skills are the ability to adapt and behave positively as a provision for each individual to face the demands and challenges of life effectively (Prajapati *et al.*, 2017). This is an effort to prepare the demands concerning National Education Standards, namely having the ability to convey original ideas, making creative actions and works, and being able to find alternative solutions to problems in their environment.

The contribution of industrial society to education is to provide technological development innovations in building innovative generations that excel in the industrial and social fields (Gonçalves *et al.*, 2023). To achieve the goal of the era of society 5.0, namely creating a "human centric society," encouraging community economic development and providing solutions to improving the quality of life of the community (Alimohammadlou & Khoshsepehr, 2023). Entrepreneurship skills are one of the life skills needed in the era of Society 5.0. Entrepreneurship is a skill that makes someone entrepreneurial-minded and able to develop a business (Lackéus, 2020). The importance of students having life skills in entrepreneurship is to meet the primary goal of the era of Society 5.0, which is to create community welfare through economic growth (Al Mamun *et al.*, 2019; Đorđević *et al.*, 2023). However, students' entrepreneurship skills are still relatively low (Krisnawati *et al.*, 2021). One of the factors in the low

entrepreneurship skills of students is the limited facilities of teaching modules that are able to develop entrepreneurship skills in schools. Previous research reveals that lack of practical experience in entrepreneurship and inadequate curriculum are some of the main obstacles to developing entrepreneurial skills of high school students in Indonesia (Porfirio *et al.*, 2022). Students are still limited in carrying out entrepreneurial practices to the analysis of entrepreneurial success calculations (Mulyani, 2018).

The teaching module is a tool, media facility, method, guide, and learning guide from the independent curriculum as a substitute for lesson plan in the 2013 curriculum. Previous research reports that teaching modules integrated with project-based learning (PjBL) models most effectively train entrepreneurship skills (Abdullahi *et al.*, 2020). Through projects, students can simulate real-world entrepreneurial experiences (Hayati, 2022). Through this learning model, students can develop their creativity, critical thinking, problem-solving, and teamwork skills (Wang *et al.*, 2022). Students can also increase their self-confidence, improve their decision-making and leadership abilities, and increase their knowledge of the entrepreneurial context.

Entrepreneurship can be integrated into biological material, namely entrepreneurship based on scientific studies by utilizing biology learning (Bioentrepreneurship) (Mahmudi *et al.*, 2020). Plant growth and development material is used as an entrepreneurial idea for organic vegetable cultivation with the microgreens method. Cultivation of microgreen vegetables is an effort to meet community demand to fulfill a healthy lifestyle by consuming vegetables that are free of chemicals. Healthy vegetables have food nutrition and food safety criteria. Through the integration of project-based learning and material on the growth and development of microgreen cultivation plants in teaching modules, students' bioentrepreneurship skills will be trained. There are four indicators of bioentrepreneurship skills (Acs *et al.*, 2017), namely (1) observation of problems based on scientific studies, namely the ability of students to analyze problems and theoretical concepts, (2) product innovation, namely the ability of students to be skilled in making solutions and product innovations from the problems encountered, (3) analysis of research results, namely the ability of students to analyze sales results, (4) reflection, namely the ability of students to have related awareness. Efforts have been made to train bioentrepreneurship skills.

PjBL has been identified as an effective approach to enhancing entrepreneurial skills in higher education (Sang & Van, 2016; Santoso *et al.*, 2023). However, there is a research gap regarding the impact of PjBL specifically on bio-entrepreneurship. Some research has focused on the impact of PjBL on entrepreneurship education in general, but there is limited research on its applicability and effectiveness in bio-entrepreneurship contexts (Hayati, 2022; Santoso *et al.*, 2023). Some studies have found that PjBL provide high-quality learning environments and improve learning outcomes, including the development of skills such as leadership (Lucas & Goodman, 2015) and problem-solving skills (Parno *et al.*, 2020). Other studies show that this learning model can improve entrepreneurial learning outcomes (Hayuningtyas *et al.*, 2019), showing its effectiveness in improving entrepreneurial skills. However, further research is needed to explore the specific impact of project-based learning on bio-entrepreneurship, particularly in education in Indonesia. Therefore, this study aims to develop and describe the validity and practicality of project-based learning teaching modules to train life skills society 5.0 (bioentrepreneurship). The development of teaching modules in this study contains features that can train students' bioentrepreneurship so that Life Skills Society 5.0 can be facilitated. The analysis in this study is descriptive quantitative. The results of the development of teaching modules are expected to be used by teachers in training students' bioentrepreneurship through biology learning as a provision to realize the era of society 5.0.

## Method

### Research design

This type of research is research development (Research and Development). This research design applies the 4D (define, design, development, and disseminate) model (Thiagarajan *et al.*, 1974). This research was conducted at the Postgraduate Study Program in Biology Education, Surabaya State University. The first stage is divided into several stages, namely curriculum analysis, student analysis, task analysis, material analysis, and formulation of the flow of learning objectives. Furthermore, the design stage includes the selection of instruments, the selection of attachments to teaching modules (textbooks, student worksheet), the selection of formats, and the initial design. Then, the development stage contains expert validation and revision. The implementation stage includes assessing the practicality of the attachment of teaching modules, namely textbooks, through readability tests. This research is limited to the development process, validity, and practicality of the product. The sample of this study was 60 students of grade XII SMAN 14 Surabaya. The steps of the research method are interpreted in Figure 1.

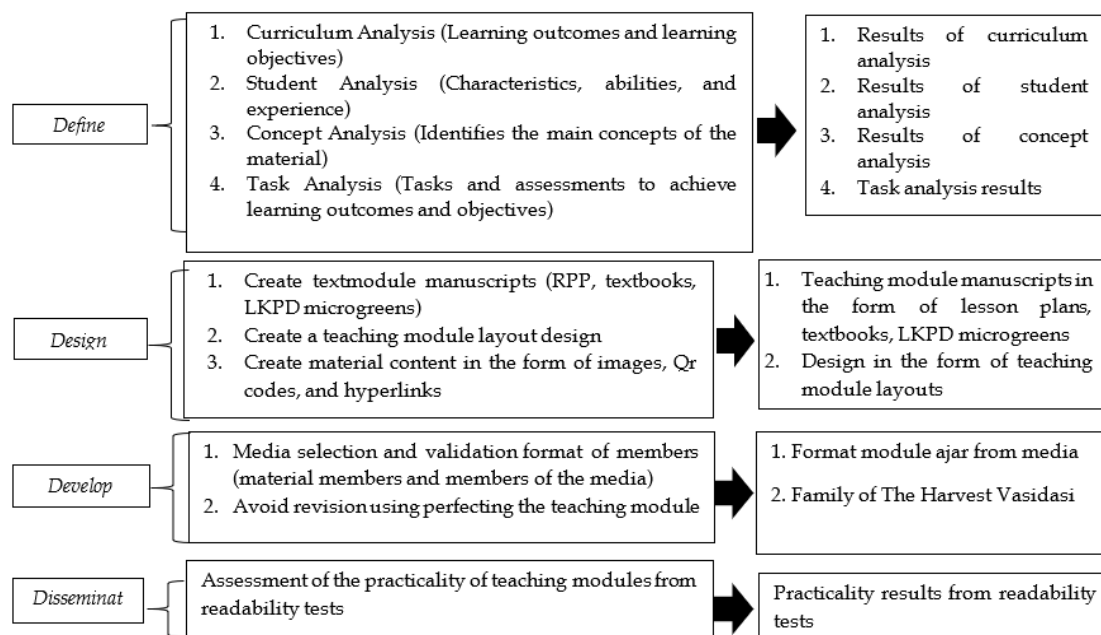


Figure 1. Research methods

## Context and sample

This stage of research corresponded to the 4D research model. The first stage was separated into various stages, including initial final analysis, student analysis, task analysis, material analysis, and learning aim formulation. The design step follows, which includes selecting instruments, teaching module attachments (textbooks, student worksheet), forms, and preliminary design. The development step then included expert validation and revision. This research was limited to the product's development process, validity, and practicality. The sample for this research consisted of 60 class XII students from SMAN 14 Surabaya.

## Data sources

The data used originated from instruments developed by researchers. The instruments utilized were non-test instruments, such as validation sheets and practicality sheets. The data collection method used the method of validating teaching module devices and calculating the readability level of textbooks. The validation sheet used a Likert scale to assess four aspects: (1) presentation eligibility, (2) content suitability, (3) linguistic appropriateness, and (4) attainment of markers for practicing bioentrepreneurship skills. The readability of the textbook was used to compute the practicality of the teaching module, which was then included in the fry diagram.

## Data analysis

The validation results are analyzed descriptively and quantitatively. The validity of the device is analyzed after obtaining a score from the validator and looking for the average score of each aspect. The results of the validation data for teaching module development will be determined using the Likert scale (Table 1).

Table 1. Likert scale

Score	Category
4	Very Good
3	Good
2	Quite Good
1	Not Good

The validation scores on each aspect of the assessment obtained from the three validators are averaged. Furthermore, the average value of the validation value of all aspects is determined. The average value of the total validation of all aspects is used to determine the level of validity of the teaching module. The values obtained are interpreted based on the interpretation of validity as in Table 2.

Table 2. Validation data interpretation criteria

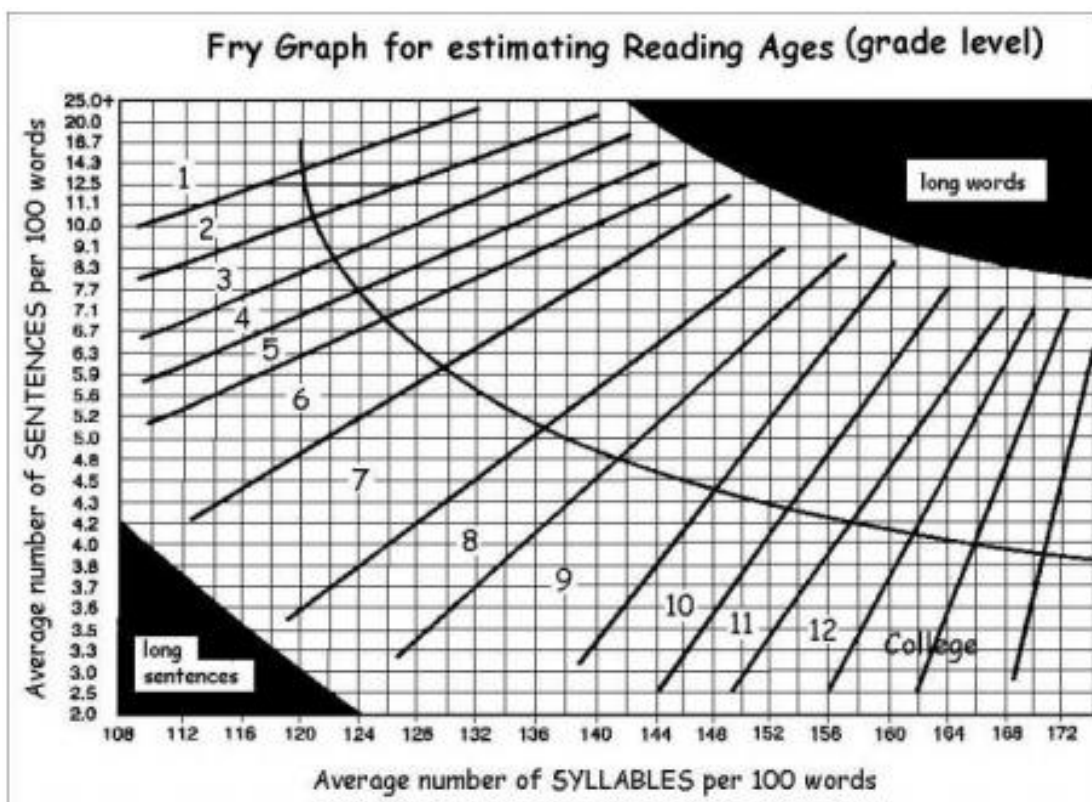
Scale Value	Category
3.26 – 4.00	Very Valid
2.51 – 3.25	Valid
1.76 – 2.50	Quite Valid
1.00 – 1.75	Not Valid

Based on the teaching module validation data analysis technique above, it can be concluded that the teaching module developed is said to be valid, feasible and can be used in learning activities if the average score reaches  $\geq 2.51$ .

Practicality is seen from the results of textbook readability. There are two factors in the fry graph formula, namely the number of sentences and the number of syllables. The readability value is obtained from 100 words in the reading taken from the developed textbook, then calculated the number of sentences and the number of words. If of the 100 words there are words that do not reach the end of the sentence, then the number of sentences in the calculation is not always intact but there is a remainder, then calculated using the following formula:

$$\text{Number of remaining sentences} = \frac{\text{number of words in a sentence that reaches 100 words}}{\text{number of words in the last sentence}}$$

From the calculation results, the number of remaining sentences is converted in the vertical axis in the fry graph, while the number of syllables multiplied by 0.6 is then converted to the horizontal axis in the fry graph (Figure 2).


 Figure 2. Fry Graph (Yasa *et al.*, 2013)

Textbook readability is appropriate if the intersection of the vertical line indicating the number of sentences per 100 words and the horizontal line indicating the number of syllables per 100 words are located at levels 9-12. The readability level of discourse should be increased by one level and reduced by one level (Yasa *et al.*, 2013).

## Results and Discussion

The defining stage includes curriculum analysis, student analysis, task analysis, material analysis, and formulation of learning objectives flow. The curriculum used is an independent curriculum, with learning outcomes in phase F about plant growth and development material. The concept of plant growth and development material presented in this teaching module includes germination, primary and secondary growth, and factors that affect growth and development. Plant growth and development material is implemented in the cultivation of microgreen vegetables. This project-based learning teaching module was developed for limited trials for grade XII students of SMAN 14 Surabaya. Furthermore, the design stage includes instrument selection, selection of teaching module attachments (textbooks, student worksheet), feature selection, format selection, and initial design. An overview of teaching modules is presented in [Figure 3](#). Then, the development stage contains expert validation and revision. The implementation stage includes assessing the practicality of the attachment of teaching modules, namely textbooks, through readability tests.



Figure 3. Display of project-based learning-based teaching module: (a) module cover page, (b) sample of content page in module, (c) textbook cover page, (d) sample of content page in textbook, (e) student worksheet I cover page; (f) student worksheet II cover page; (g) student worksheet feature mapping, (h) student worksheet content page

## Validation

The validation of teaching modules is reviewed from three aspects, namely, the feasibility of presentation, content, and language. Three validator lecturers carry out validation; the validation results are presented in [Table 3](#). Overall, the validity score of the developed teaching module obtained an average score of 3.8 with a very valid category, so this teaching module is very feasible to be used in learning. A graph of overall validity results is presented in [Figure 4](#).

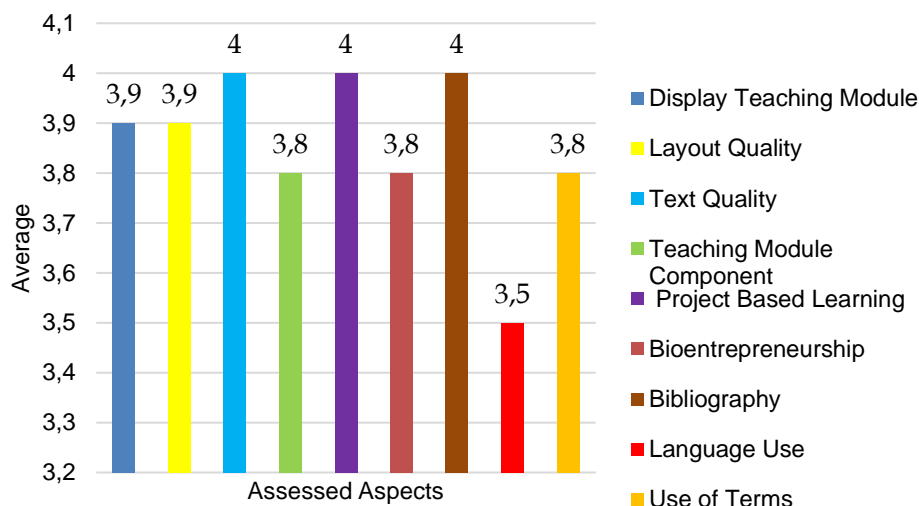


Figure 4. Teaching modules validity results

The results of the recapitulation of the validity of the teaching module showed an average score of Display Teaching Module 3.9; Layout Quality 3.9; Text Quality 4; Teaching Module Component 3.8; Project Based Learning 4; Bioentrepreneurship 3.8; Bibliography 4; Language Use 3.5; Use of Terms 3.8.

Table 3. Recapitulation of the validation results of project-based learning-based teaching modules plant growth and development material to train life skills society 5.0

No.	Rated Aspect	Average	Category
1.	Presentation eligibility		
	1) Display of Teaching Module	3.9	Very Valid
	2) Quality of Layouts	3.9	Very Valid
	3) Quality of Text	4	Very Valid
2.	Content suitability		
	1) Component of Teaching Module	3.8	Very Valid
	2) Aspect of <i>Project-Based Learning</i>		
	a. Using the learning framework of <i>Project-Based Learning</i>		
	b. The learning steps include a sequence of <i>Project Based Learning</i> activities (problem analysis and project determination, project planning, teacher monitoring, and project progress, presentation	4	Very Valid
	c. Integrating learning concepts into models		
	d. <i>Project-based learning</i> resources (books, student worksheet) are available.		
	3) Aspect of <i>Bioentrepreneurship</i>		
	a. Learning objectives include <i>bioentrepreneurship</i> activities		
	b. The learning steps contain <i>bioentrepreneurship</i> indicators	3.8	Very Valid
	c. <i>Bioentrepreneurship</i> learning resources (books, student worksheet) are available.		
	d. The assessment method evaluates students' knowledge in <i>bioentrepreneurship</i> .		
	4) References	4	Very Valid
3.	Linguistic appropriateness		
	1) Use of Language	3.5	Very Valid
	2) Use of Terms	3.8	Very Valid
total average of teaching module validity		3.8	Very Valid

This research produced a project-based learning teaching module to train Life Skills Society 5.0 (Bioentrepreneurship). The teaching modules developed consist of lesson plans, textbooks, student

worksheets, and assessment instruments. Teaching modules are equipped with PjBL activities. Textbooks and student worksheet are equipped with features that facilitate students in practicing bioentrepreneurial skills, namely Let's Science, Let's Plan, Let's Try, Let's Analyze, and Let's Val. Teaching modules are developed on plant growth and development material that is integrated with the concept of microgreen cultivation to train learners' bioentrepreneurship skills. In the teaching module, project activities are carried out by students by cultivating vegetables with the microgreens method.

Based on the validation step, the recapitulation results are obtained in [Table 3](#) and [Figure 4](#). The recapitulation results show an average feasibility score of 3.9 with a very valid category; this shows that the appearance of the teaching module, the quality of the layout, and the overall quality of the text are appropriate so as to foster students' interest in learning.

The content eligibility is 3.9, with a very valid category. The feasibility aspect of the content is reviewed, the first being the teaching module component. The developed teaching module has three components, including general information, core information, and attachments. General information contains the identity of the author, initial competencies, Pancasila student profile, facilities and infrastructure, target students, and the learning model used. Core information contains learning objectives, meaningful understanding, lighter questions, lesson preparation, learning activities, assessment, enrichment, and remedial, and student and teacher reflection. At the same time, the attachment contains student worksheets (student worksheet), textbooks, glossaries, and bibliography. This shows that the teaching modules developed are in accordance with the demands of the independent curriculum and material. Second, aspects of PjBL are reviewed from (1) Using the PjBL learning model, (2) The steps in learning contain the sequence of PjBL activities (problem analysis and project determination, Preparation of project planning, Monitoring teachers and project progress, Preparation of presentation reports and project publications), (3) Integrating learning concepts into the project, (4) There are project-based learning resources (textbooks, student worksheet). Third, aspects of Bioentrepreneurship in terms of (1) Learning objectives include Bioentrepreneurship activities, (2) Learning steps contain Bioentrepreneurship indicators, (3) There are learning resources (books, student worksheet) based on Bioentrepreneurship, (4) Assessment methods measure students' understanding of Bioentrepreneurship. The teaching module has also met aspects of PjBL and bioentrepreneurship skill indicators.

Language eligibility of 3.6 with a very valid category. Linguistic aspects are viewed from the use of language and the use of terms. This shows that the language used in the teaching module is easy to understand, communicative, and efficient. The teaching module uses biology terms correctly, and the sentences in the teaching module are clear and easy to understand. The results show that the indicators of coherence and language use are appropriate ([Sary et al., 2023](#)).

Based on the description of the validation results above, an overall average score of 3.8 was obtained with a very valid category so that the teaching modules developed are practical if applied to learning. This is based on the learning activities used in the teaching module. Teaching modules developed based on PjBL. In line with the research of [Abdullahi et al. \(2020\)](#), the PjBL learning model is the most effective learning for training students' entrepreneurial skills or bioentrepreneurship. Learning in teaching modules is problem-based around and has the aim of preparing individuals who have bioentrepreneurship skills, namely observation of problems based on studies, scientific product innovation, analysis of research results, and reflection.

Activities and features in student worksheet can facilitate students in bioentrepreneurship skills. These features include: (1) Let's Science: facilitates students to make concept discovery and analysis of plant growth and development factors based on scientific studies as a direction for problem orientation; (2) Let's Plan: facilitates students to compile solutions to problems that have been analyzed in the form of microgreens cultivation, (3) Let's Try: facilitates students to create project timelines, observation methods, and product marketing concepts, (4) Let's Analyze: facilitates students in analyzing product trial results based on the selling price per unit, profit, payback period, and Break Event Point (BEP), (5) Let's Val: facilitates students to do self-reflection by filling in questions Student worksheets are a medium that can stimulate students' psychomotor, cognitive, and affective development. The learning can influence increased entrepreneurial interest in students. Educational institutions are responsible for guiding their students and providing motivation so that they dare to be entrepreneurial. Bioentrepreneurship is a pioneer in Indonesia and can provide new and considerable startup potential if developed.

## Practicality

The practicality of teaching modules is imitated from the readability of textbooks, the results of textbook readability are presented in [Table 4](#). The results of the calculation of the number of sentences and syllables are then converted on the Fry graph, presented [Figure 5](#). Based on [Figure 5](#), the readability test results in the five samples used obtained an average number of sentences of 4; The number of syllables is 162.4, so it is at level 12. These results show that there is a match with the target of using high school books, so textbooks are practical in terms of readability. In the preparation of textbooks,

attention must be paid to the compatibility between the level of readability and the level of thinking of students so that students can understand the reading (Mahendri *et al.*, 2022). According to (Aristyasari *et al.*, 2023), the ease of students using learning media is one of the practical values of learning media. Readings that have a high readability level are easier to understand, and vice versa; the lower the readability level of reading, the more complex the reading, and the more difficult it is to understand (Aristyasari *et al.*, 2023). The calculation of readability using the Fry diagram graph is expected to obtain a book level that is in accordance with the competence of students in understanding the readability of the text (Shiyamsyah & Yuliani, 2022).

Table 4. Recapitulation of readability level of PjBL textbooks plant growth and development material to train bioentrepreneurship skills

No.	Section	Page	Number of Sentences	Number of Syllables	Level
1.	Understanding plant growth	10	3	158	12
2.	Germination	14	6	160	11
3.	Flowering	24	4	170	14
4.	Bioentrepreneurship	42	4	165	13
5.	Microgreens	45	3	159	12
Total Average			4	162.4	12

The learning developed in this research is directed at empowering students' entrepreneurial competencies. Entrepreneurship skills are a crucial competency in the 21st Century (Geisinger, 2016; Obschonka, 2014). Entrepreneurship-based learning can improve employability skills, creativity, problem-solving, and business knowledge (Kucel *et al.*, 2016). This kind of learning can form an entrepreneurial mindset and encourage students to carry out entrepreneurial activities. Apart from that, entrepreneurship skills will also prepare students to face the turbulent and unpredictable labor market (Milohnić & Licul, 2018).

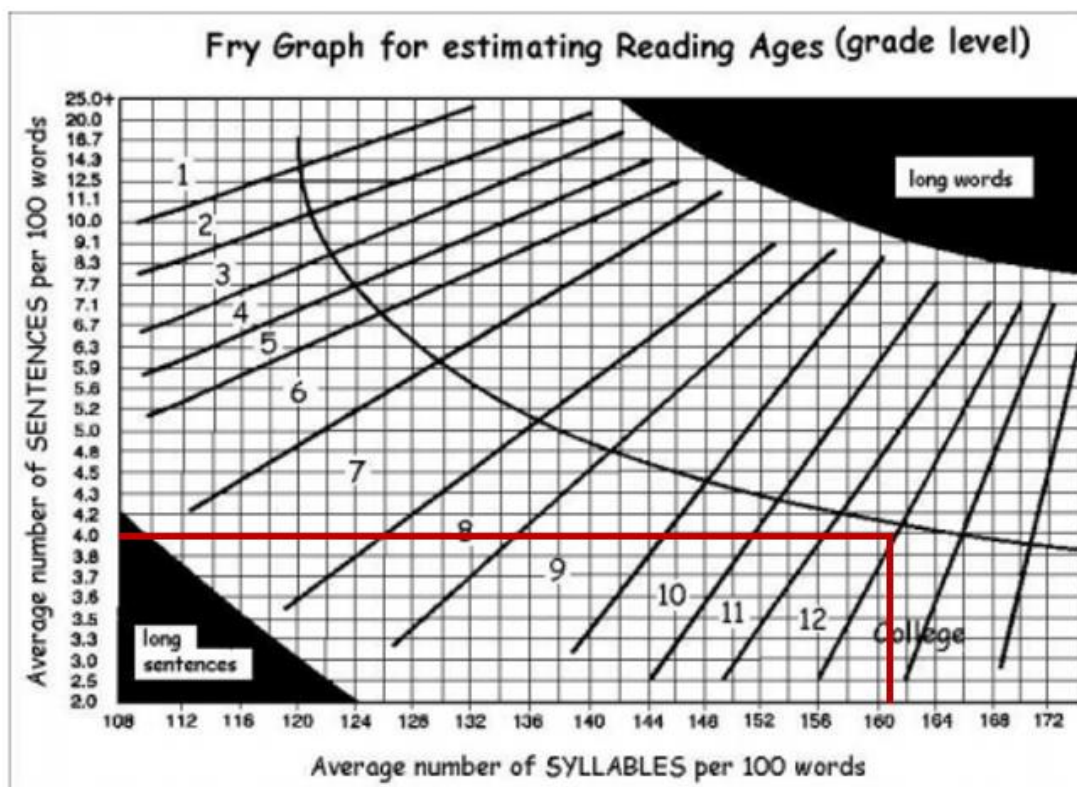


Figure 5. Readability test results

By the application of learning that integrates PjBL models with plant growth and development material, students are able to carry out bioentrepreneurship activities well. In various previous studies, PjBL was also reported to have a significant effect on improving students' entrepreneurial skills (Divac *et al.*, 2022;



Elfayetti *et al.*, 2023). Through this model, students can improve competencies related to entrepreneurship, such as entrepreneurial spirit, entrepreneurial culture, and entrepreneurial capacity (Wang *et al.*, 2022). This learning model can also create a flexible learning environment and support industry-oriented skills and knowledge (Hayati, 2022). The teaching module can be developed and implemented on Project P5 activities in the independent school curriculum. Increasing entrepreneurial interest in students can be influenced by the learning that is carried out. Educational institutions are responsible for guiding their students and providing motivation so that they dare to be entrepreneurs. Bioentrepreneurship-oriented learning activities can increase students' activities in economic, social, educational, and other fields. With the product innovation resulting from bioentrepreneurship activities, it is a potential modern business that is in demand by many people, especially millennials and Gen Z. The innovation can be developed so that it can achieve some of the demands of the society 5.0 era.

## Conclusion

Based on the results of research, PjBL teaching modules on plant growth and development material to train the skills of the Society 5.0 era (bioentrepreneurship) are valid and practical to be used in learning. This finding is supported by the results of the study, which shows the overall average validity of teaching modules of 3.8 with a very valid category. It is convenient in terms of textbook readability for students at level 12. Teaching modules can be used by teachers in training students' Society 5.0 (bioentrepreneurship) era skills through biology learning as a provision to realize the era of Society 5.0. With the product innovation resulting from bioentrepreneurship activities, it is able to become a potential modern business that is in demand by many people, especially millennials and Gen Z. The innovation can be developed so that it can achieve some of the demands of society 5.0 era. Based on the results of the research, the author recommends using PjBL teaching modules on plant growth and development in learning to establish the effectiveness of developing the bioentrepreneurship skills of students.

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## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

## Author Contributions

**F. S. F. Shiyamsyah:** methodology, analysis, original manuscript authoring, reviewing, and editing. **Y. Yuliani:** reviewing and editing. **Y. S. Rahayu:** reviewing and editing.

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