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Development of Student Worksheets Based on Integrated Field-Based Learning Using PlantNet in Teaching Plant Classification to Seventh Grade Junior High School Students

Al Fina Nurul Aisyah[1], Rafiatul Hasanah[2]
[1,2]Science Education Departement, Universitas Islam Negeri Kiai Haji Achmad Siddiq, Jember
Correspondence e-mail: alfina06aisah@gmail.com

Abstract:
The development of the digital era has encouraged the use of information and communication technology as one of the important pillars of 21st century learning innovation. Mobile phone-based applications such as PlantNet can be used to help students identify plants directly in their surroundings. Based on an analysis of student needs, 62% prefer practical-based instructional materials, 70% prefer mobile-based learning applications, and 84.6% opt for learning activities involving practical exercises. Plant classification material is still considered challenging by the majority of students. Science teachers noted that instruction remains predominantly lecture-based, relying on limited worksheets and textbooks. Teachers also suggested the development of more innovative instructional materials without abandoning the worksheet format. This study aims to describe the validity, practicality, and effectiveness of the PlantNet application-assisted practical workbook for seventh-grade plant classification material at SMPN 1 Jenggawah. The type of research used is Research and Development (R&D) with the ADDIE model. Data collection techniques include observation, interviews, questionnaires, and tests. The validation results showed a percentage of 88.1% (content) and 92.8% (media), falling into the highly valid category. Practicality reached 85.7% (teachers and students), as well as 94% and 90% from student trials. Effectiveness, based on the N-gain test, was 0.8 and 0.7, falling into the high category.

Keywords: Student Worksheet, Field-Based Learning, PlantNet, Plant Classification

Introduction

Education plays an important role in shaping individuals who are intelligent, moral, and able to face the challenges of the times. Education not only instills knowledge, but also shapes character, ethics, and skills in line with the values of national life. Law No. 20 of 2003 on the National Education System states that education is a conscious and planned effort to create a learning environment and learning process so that students actively develop their potential to have spiritual and religious strength, personality, intelligence, noble character, and the skills needed by themselves and society (National Education System Law, 2003).

One subject that plays an important role in developing scientific thinking skills is Natural Sciences (IPA). IPA learning aims to form students' understanding of scientific concepts and encourage them to think critically and systematically (Sakdiah, 2019). However, in practice, many students experience difficulties in understanding abstract IPA material, one of which is plant classification. This material requires observation, grouping, and understanding of taxonomic concepts based on the characteristics of living things (Rifa'i, Kurniawan, & Hasanah, 2020).

Based on the results of a needs analysis at SMPN 1 Jenggawah, 62% of students want practical teaching materials, 70% prefer mobile app-based learning, and 84.6% prefer practical activities. Unfortunately, the teaching methods used are still dominated by lectures with teaching materials in the form of workbooks and limited textbooks. Students say that this type of learning makes them bored and difficult to understand the material in depth.

The integration of technology in learning has been proven to improve the effectiveness and interactivity of the teaching and learning process. One technology that can be utilized in plant classification learning is the PlantNet application. This application is an international collaborative project based on artificial intelligence that allows users to identify plant species simply by taking photos of plant parts such as leaves, flowers, or stems. The identification results display the species name along with its taxonomic classification from the family, genus, to species level, complete with scientific data and geographical distribution (Sugandi, Rasyid, & Gaffar, 2020). The app supports Android and iOS operating systems and provides a database of plants from various continents such as Asia, Africa, Europe, and America, making it a widely accessible educational tool (Rifa'i, Kurniawan, & Hasanah, 2020). This is in line with the research by Rifa'i, Kurniawan, and Hasanah (2020), which found that the use of PlantNet can motivate students in recognizing plant taxonomy due to its comprehensive and user-friendly features. Previous studies have also shown that innovative digital-based media can improve learning outcomes. Dafrita and Trisianawati (2024) developed a PlantNet-based practical module and obtained highly valid and practical results, with an N-Gain value of 0.6, which falls into the moderate category. A similar study was conducted by Kurniawan and Hasanah (2022) through the development of a quarted card game, which proved to be highly valid and engaging in helping students understand the material on the classification of living organisms.

Therefore, the development of Student Worksheets (SW) that combine practical and technological approaches through the PlantNet application is considered potential to address the challenges of science education in the field. The ADDIE (Analysis, Design, Development, Implementation, and Evaluation) development model was used in this study because it offers a systematic, structured, and flexible approach, which is suitable for the development of contextual learning media (Sugiyono, 2019). This innovation is

expected to meet students' needs for interactive, applicable, and relevant teaching materials in line with the times.

Methods

This research is a type of research and development (R&D) using the ADDIE development model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. This model was chosen because it provides systematic steps that are appropriate for the development of technology-based teaching materials (Sugiyono, 2019).

The research subjects were 31 students in class VII G at SMPN 1 Jenggawah. The research was conducted in the even semester of the 2024/2025 academic year. The analysis stage was carried out by identifying problems at the school, including analyzing the needs of students and teachers through interviews and questionnaires. The design stage was carried out by designing the structure of the Student Worksheet (LKS), learning syntax, and scenarios for using the PlantNet application in practical activities.

The development stage included the creation of LKS assisted by the PlantNet application, which was developed based on the design results and input from the supervising lecturer. Validation was carried out by two subject matter experts and two media experts to assess the feasibility of the content, language, presentation, and graphics. The validation scores were converted into qualitative categories using percentage interpretation (Akbar, 2022).

The implementation stage was conducted in two trials: a small-group trial (10 students) and a large-group trial (31 students). These trials aimed to assess the practicality and effectiveness of the LKS. Practicality was measured based on student and teacher responses to the use of the LKS in plant classification learning, while effectiveness was measured based on improvements in student learning outcomes before and after learning (pretest and posttest).

The instruments used in this study include: expert validation sheets, teacher and student response questionnaires, pretest and posttest questions, and observation sheets.

The validation data were analyzed descriptively and quantitatively using the following formula:

$$V_{ah} = \frac{Tse}{Tsh} \times 100\%$$

Explanation:

V_{ah} = Expert validation

Tse = Total empirical score

Tsh = Total expected score

The categorization range is shown in the following table:

Table 1 Validity Criteria

Validity Criteria	Level of Validity
86,00% -100 %	Very valid, can be used without modification.
71,00% - 85,00 %	Valid, can be used with minor revisions

56,00% - 70,00 %	Sufficiently valid, can be used after major revisions
41,00% - 55,00 %	Insufficiently valid, cannot be used
25,00% - 40,00 %	Invalid, cannot be used

Source: Akbar, 2022

Effectiveness data was analyzed using the N-Gain formula:

$$N_{Gain} = \frac{post-test\ score - pre-test\ score}{ideal\ score - pre-test\ score} \times 100\ \%$$

Explanation:
Pre-test score = Pre-test score
Post-test score = Post-test score
Ideal score = Expected score

Table 3 Normalized Gain Criteria

N-Gain Value	Interpretationi
0,70 ≤ g ≤ 100	High
0,30 ≤ g < 0,70	Moderate
0,00 < g < 0,30	Low
g = 0,00	No increase
-1,00 ≤ g < 0,00	Decrease

(Source: Book N-Gain vs Stacking)

Results and Discussion

This study produced a product in the form of a Student Worksheet (LKS) for practical work assisted by the PlantNet application for plant classification material. The development process was carried out through five ADDIE stages and has undergone validation, practicality testing, and effectiveness testing.

1. Expert Validation

Validation was carried out by two subject matter experts and two media experts who assessed the content, language, presentation, and graphics.

Table 4. Results of LKS Validation by Experts

No	Aspects Assessed	Maximum Score	Score Obtained	Percentage	Category
1	Subject Matter Expert	160	141	88,4%	Highly Valid
2	Media Expert	125	116	92,8%	Highly Valid

The results of expert validation show that the LKS obtained an average percentage of 88.4% in the highly valid category. This percentage was obtained from four aspects of

assessment: content suitability (85%), presentation suitability (90%), language suitability (84.4%), and contextual assessment (94.3%). This high score indicates that the LKS is in line with the Learning Objective Flow (ATP) and learning outcomes, presents material in a logical sequence, uses communicative language, and is able to relate the material to everyday life contexts. This aligns with the research by Purwandi & Hasanah (2022), which reported an expert material validation percentage of 96.12% in the "highly valid" category. Additionally, the use of the PlantNet application reflects state-of-the-art knowledge by leveraging the latest technology relevant to advancements in plant classification science.

Media expert validation obtained a percentage of 92.8% (very valid category), indicating that the LKS has excellent graphic quality. Visual elements such as layout, color, typography, and illustrations have been designed to support readability and student understanding. Setiawan's research shows that high content and visual appeal (98.44% and 95.83%) contribute to improved student understanding. The selection of simple and user-friendly typography is also in line with Setiautami's recommendation that easy-to-read font design can enhance student learning comfort.

2. Practicality Test Results

Practicality was measured through questionnaires completed by teachers and students after the lesson.

Table 5. LKS Practicality Test Results

No	Subject of Respondents	Maximum Score	Score Obtained	Percentage	Category
1	Science Teacher	70	61	86,1%	Very Practical
2	Students (Small Group)	440	427	94%	Very Practical
3	Students (Large Group)	2100	1891	90%	Very Practical

The practicality of the worksheets based on user responses showed an average of 86.1% (very practical category). The interest aspect scored 93.3%, material 85%, and language 80%. This shows that the worksheets are able to motivate students, present relevant material, and use language that is easy to understand. In line with the research by Ayulubna et al. (2012), the development of LKS oriented toward the Comparison and Contrast Web strategy also increases student activity and learning outcomes in Spermatophyta material. According to product component theory, a teaching material is considered practical if it is easy to use (usable) in learning.

During the implementation phase, a small-scale test (8 students) yielded a readability score of 94% (very interesting), while a large-scale test (28 students) resulted in an average of 90% with the same category. The assessment of the interest aspect at 88.4%, material at 90.5%, and language at 92.1% shows that the worksheet is able to increase interest, conceptual understanding, and learning comfort. Maftuhatus Shohihah et al.'s research also found that learning that actively involves students can significantly improve understanding and learning outcomes.

3. Effectiveness Test Results

Effectiveness was measured using pretest and posttest analyses conducted using N-Gain.

Table 6. Effectiveness Test Results (N-Gain)

	Small Scale Testing		Large Scale Testing	
Description	*Pretest*	*Posttest*	*Pretest*	*Posttest*
Number of students	8	8	28	28
Lowest score	30	80	20	70
Highest score	60	100	70	100
Average score	**43,73**	**92,5**	**44,28**	**86,4**
N- gain	0,8		0,7	
Criteria	High		High	

The effectiveness of the worksheets was tested through pretest-posttest with N-Gain analysis. In the small-scale test, the N-Gain was 0.8 (high category) and in the large-scale test it was 0.7 (high category). These values indicate a significant improvement in students' understanding after using the LKS. Dwo et al. (2024) reported an N-Gain of 0.6 (moderate category), meaning that the findings of this study are higher. This demonstrates that the PlantNet-assisted LKS developed is not only valid and practical but also effective in improving students' science learning outcomes.

Conclusion

1. Feasibility, The PlantNet application-assisted practical workbook meets the criteria for content, language, presentation, and graphics with a very valid category, based on the results of material expert validation (88.4%) and media expert validation (92.8%).
2. Practicality, Teacher and student responses (small and large scales) indicate a highly practical category with an average of 88.05%, meaning the LKS is easy to use, engaging, and motivating for students in learning.
3. Effectiveness, Effectiveness testing using N-Gain shows an increase in student learning outcomes with a high category, namely 0.8 for the small scale and 0.7 for the large scale, which proves that the LKS is able to improve students' understanding of concepts, observation skills, and learning motivation.

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