

DEVELOPMENT OF IPAS PROJECT E-MODULES THROUGH A PROJECT-BASED LEARNING (PJBL) APPROACH TO IMPROVE SCIENTIFIC LITERACY, ON SUBSTANCE MATERIALS AND THEIR CHANGES

Rita Donna Hutahaean¹⁾, Tiurlina Siregar²⁾, Johnson Siallagan³⁾, Ortis Fredy Waromi⁴⁾

¹⁾ Papua Special Tourism State School, Indonesia; hutahaeanrita@gmail.com

²⁾ Master of Science Education Study Program, UNCEN, Indonesia; tiurlina.siregar66@gmail.com

³⁾ Master of Science Education Study Program, UNCEN, Indonesia; siallagan1968@gmail.com

⁴⁾ Biology Education Study Program, UNCEN, Indonesia; waromiof@gmail.com

Abstract: Development of the IPAS Project e-module through the Project Based Learning (PjBL) approach to improve scientific literacy in substance materials and their changes. The objectives of the research are (1) designing e-modules through the PjBL approach, (2) Feasibility analysis of e-modules, (3) Evaluation of improving scientific literacy. The research method used is Research and Development (R&D) with a 4D (Define, Design, Develop, Disseminate) development model. The research was conducted at the Papua Special Tourism State School with a total of 30 students. The results of the study show that: (1) E-modules through the PjBL approach are made through the first stage is definition, the second is data collection, the third is making a module design, the fourth is validating the model design, the fifth is revising the module design, the sixth is a small-scale trial, then a large-scale trial to obtain scientific literacy data in learning, as well as the response of IPAS Project teachers to the module. (2) The feasibility analysis of the e-module was obtained through validation of validators (92.36% of the category strongly agreed), peer feasibility test (94.65% of the category strongly agreed) so that it was declared very feasible to use (3) The evaluation of scientific literacy improvement was obtained that the increase in scientific literacy increased in RPP 1 by 15.53%, in RPP 2 by 45.13%, in RPP 3 by 52.24% with an average value increase in the three meetings of 35.86% after using the module The IPAS project in learning so that significantly the application of e-modules through PjBL is effectively used as a contextual learning medium at the vocational school level.

Keywords: E-module, Project-Based Learning (PjBL), Science Project, scientific literacy

1. INTRODUCTION

Education is one of the main pillars in nation building. Through education, the young generation is prepared to face increasingly complex global challenges as well as being required to be able to contribute to the progress of the nation. The Government of Indonesia continues to make various efforts to reform the education system to be relevant to the times, such as the implementation of the Independent Curriculum which emphasizes student-centered learning, strengthening essential competencies, and learning through a project approach (Ministry of Education and Culture, 2022). This is carried out in schools, including Senior High Schools (SMA), Vocational High Schools (SMK).

IPAS Project Learning is packaged in the form of learning through a Project-Based Learning (PjBL) approach that integrates all aspects of natural and social sciences. PjBL is a teaching approach that is built on learning activities and real tasks that provide

challenges for students related to daily life to be solved in groups. Each project is carried out to achieve all competencies in subject elements contextualized by the characteristics of each field of expertise (Ministry of Education and Culture 2025). The fact found in the field is that at the Papua Special Tourism State School, learning has not been carried out using books or electronic modules that go through a project approach.

E-modules are teaching materials that are systematically packaged in digital form to make it easier for students to learn independently according to the competencies that must be achieved. Prastowo, A. (2014). E-modules allow the integration of text, images, videos, animations, and interactive quizzes, thus making learning more interesting and in accordance with the characteristics of vocational school students who tend to be visual and practical. In addition, e-modules are flexible, can be accessed anytime and anywhere, and encourage students to learn independently (Suryani & Fathurrahman, 2020). Furthermore, the development of e-modules also supports government policies in digital literacy education and is in line with the direction of the Independent Curriculum which emphasizes student-centered, achievement-oriented learning, and encourages learning through a project approach. (Ministry of Education and Culture, 2022).

According to Tiurlina Siregar, et al (2023) in the development of chemical e-modules based on papua local wisdom on reduction and oxidation reaction materials to increase student learning outcomes found that the results of the feasibility and effectiveness test showed that e-modules were feasible to use and provided a significant improvement in student learning outcomes.

The development of e-modules through the PjBL approach on the topic of substances and their changes is a strategic step to overcome the gap between theory and practice. The PjBL approach allows students to learn the concept of IPAS through project activities that require exploration, experimentation, and active collaboration, so that they can understand scientific principles in depth while honing high-level thinking skills. The use of interactive digital e-modules will strengthen the effectiveness of learning because it provides access flexibility, attractive visual displays, and learning activities that stimulate curiosity and creativity. Through development research through the 4D (Define, Design, Develop, Disseminate) approach, it is hoped that e-modules will be produced that are not only relevant to the needs of students, but also able to improve scientific literacy, in the material of substances and their changes. Thus, the results of this research are expected to make a real contribution to improving the quality of learning of the IPAS

Project in vocational schools, as well as becoming the basis for the formulation of contextual learning strategies that are in line with the characteristics of the Independent Curriculum.

Based on the results of observations and researchers' experiences in the learning activities of the IPAS Project at the Papua Special Tourism State School since the start of the implementation of the Independent curriculum in the 2022/2023 academic year which emphasizes project-based learning, student learning outcomes are obtained at a low of around 75%. There has been a real gap in the implementation of the IPAS Project since the Independent Curriculum was implemented. The main challenge that arises is the low involvement of students; Many of them feel unfamiliar with the material taught because they have not touched the practical aspects of the world of tourism. Currently, around 75% of learning is still dominated by the role of teachers, which indirectly limits students' space for movement to explore. Without a strong bridge between science and the context of their expertise, interest in learning decreases, which ultimately has an impact on low scientific literacy and student learning outcomes.

This research aims to develop an interactive e-module through the PjBL approach in learning the IPAS Project which is designed to improve the scientific literacy of grade X students of the Papua Special Tourism State School. Based on this background, the researcher is interested in conducting development research entitled: "Development of the E-Module of the IPAS Project Through the PjBL Approach to Improve Scientific Literacy in Substance Materials and Their Changes."

2. RESEARCH METHODS

The research was conducted using the type of development research. This development research aims to produce an interactive E-module through the PjBL approach to train and improve the scientific literacy of students of class X Hospitality A. The design model used is 4D (Define, Design, Develop and Disseminate) development. This research will be carried out in November 2025. The development stage of the interactive E-module is carried out with the competence of Hospitality expertise, the Papua Special Tourism State School. The subjects of this study are 30 students of class X Hospitality A.

The IPAS Project Module through the PjBL approach to Substance and Its Changes is made through the following stages: the first stage is the definition level,

covering problem analysis, pupil analysis, concept analysis, and learning purpose analysis. The second stage is data collection to plan the module, the third stage is to make a module design, the fourth stage is to validate the model design, the fifth stage is to revise the module design, the sixth stage is a small-scale trial, then a large-scale trial to obtain scientific literacy data in learning, as well as the response of IPAS Project teachers to the module.

The validity of the interactive E-module was reviewed based on validation by material validators, media validators, and fellow teachers of the IPAS Project at the Papua Special Tourism State School. The instrument used in determining the validity of the interactive E-module is in the form of a validation sheet consisting of criteria including the feasibility of presentation, the feasibility of content, and the feasibility of language. The validation sheet uses the Likert Scale 1-4 guidelines. The validation score is calculated on average from the three validators. After obtaining the validation results, it is then analyzed to determine the validity of the E-module using the formula:

$$P = \frac{f}{N} \times 100\%$$

Remarks: P = percentage of scores obtained, n = total scores obtained, N = total maximum scores in each aspect. The validation criteria of the validators are in accordance with Table 1.

Table 1. Validity criteria

Validity Criteria (%)	Validity Level
81 < p 100≤	Highly Valid, Can be used without revision
61 < p 81≤	Quite Valid, usable but needs revision
41 < p 61≤	Less Valid, recommended not to be used as it needs large-scale revision
0 p 41≤≤	Invalid, unusable

The percentage of validation results is then interpreted using the eligibility criteria according to Riduwan (2016), namely that interactive E-modules are declared valid if a validity score is obtained with a percentage of >60%.

The effectiveness of interactive E-modules was reviewed based on the results of scientific literacy skills, and student responses. The learning outcomes of scientific literacy skills are assessed from the results of filling out questionnaires before and after learning with interactive E-modules. Interactive E-modules are said to be effective if the score after learning with the interactive E-module is higher or increases compared to the pre-learning score with the interactive E-module and the score obtained is ≥ 50 or the

score above the Good criterion. After obtaining test scores or scores, then the percentage of positive responses of students is calculated. percentage of positive responses (Table 2).

$$P = \frac{f}{N} \times 100\%$$

Table 2. Scoring Criteria for Scientific Literacy e-module (Ridwan, 2012)

Score Interval (%)	Criteria
75 < score of 100 ≤	Excellent
50 < score 75 ≤	Good
25 < score 50 ≤	Not Good
0 score 25 ≤ ≤	Not Good

3. RESULTS AND DISCUSSIONS

The research that has been developed produces products in the form of teaching materials, namely interactive E-modules through the PjBL approach to improve scientific literacy in class X Hospitality A State School Special for Papua Tourism in the material Substances and Their Changes. The interactive e-module consists of several components, including the front cover, foreword, table of contents, introduction, instructions for use, features, concept map, content and bibliography. The layout of the interactive E-module is presented simply with the consistency of the proportions of each subject of discussion, so that students can easily understand the concept of the material. The design of the interactive E-module is made interesting to increase students' motivation and interest in learning.

The components of the interactive E-module include concept maps, material summaries, interactive videos, pre-test and post-test questions which are packaged in several features presented in the form of google form links, pre-test/post-test, A combination of materials and features presented by sequencing and synthesizing aims to practice science literacy in students. This is in accordance with the statement of Asmi (2018) that the design of grouping learning materials in modules uses sequencing and synthesizing. Sequencing refers to the formation of the structure of the delivery of subject matter, while synthesizing refers to an effort to provide information to students about the relationship between concepts, facts, principles and procedures contained in the learning material.

Scientific Literacy in this study is the ability of vocational school students to explain scientific phenomena, design investigations, and interpret scientific data and

evidence, as measured through a scientific literacy test compiled based on OECD-PISA indicators (2018). The purpose of the features presented in the interactive E-module is to train students' scientific literacy on the material of Substances and Their Changes, so that the developed E-modules are adjusted to scientific literacy indicators. Scientific literacy according to OECD-PISA (2018) consists of 3 indicators, namely Explaining scientific phenomena, Ability to use scientific methods in collecting, analyzing, and interpreting data to solve problems, Tendency to be objective, critical, open, and responsible in dealing with scientific problems.

IPAS Project E-Module Qualification through the PjBL approach

The development of the IPAS Project e-module on Substances and Their Changes through the PjBL approach was carried out through validator consultation. The validation consultation carried out was material validation and media validation.

The assessment of the IPAS Project e-module through the PjBL approach was carried out by 6 validators consisting of 3 lecturers from the Faculty of Teacher Training and Education, Cenderawasih Jayapura University, 3 cognate teachers in the field of science.

Results of the Material Feasibility Component

The results of the module assessment analysis from the aspects of material assessment, presentation, and language can be seen in Figure 1.

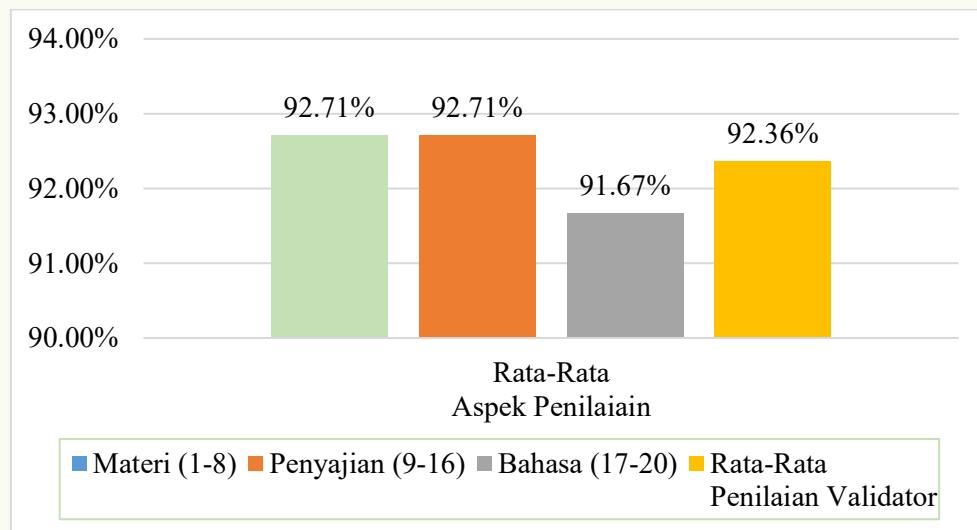


Figure 1. Module Assessment Analysis from the Assessment Aspect

Based on Figure 1. it is known that in the aspect of e-module material, an average percentage score of 92.71% was obtained, the presentation aspect obtained an average percentage value of 92.71%, and the language aspect obtained an average percentage

value of 91.67%. The average percentage of the three aspects of the assessment of 92.26% is included in the very feasible category.

The results of the feasibility analysis of the e-modules carried out are in accordance with the opinion of Tiurlina Siregar (2025), in her research that the validity of digital teaching instruments and materials is the foundation for the media to significantly increase learning activities

Media Eligibility Component

In media validation, the assessment is focused on the components of the cover, introduction, main section, and closing section. The results of the analysis of media feasibility assessment can be seen in Figure 2.

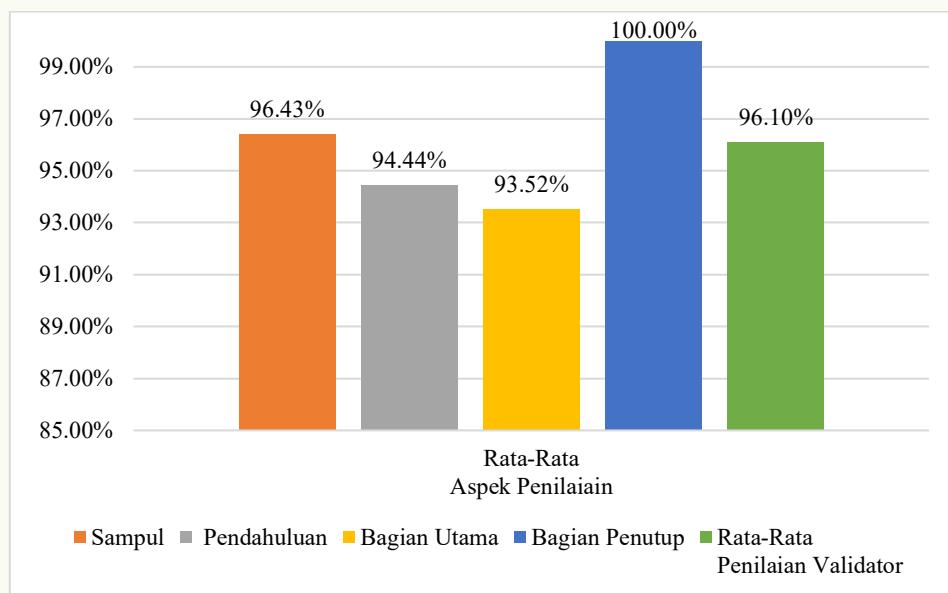


Figure 2. Media Eligibility Assessment Analysis

Based on Figure 2. It can be seen that the cover aspect obtained an average score of 96.43%, the introductory aspect 94.44%, the main part aspect of 93.53% and the closing aspect with an average score of 100%. The highest score of the four aspects is in the aspect of the closing part with an average score of 100%. The average percentage result of the fourth aspect of the assessment of 96.10% is included in the very feasible category.

This finding is in line with the principle of Ni Luh Gede Karang Widiastuti (2021) that aesthetic appeal is the main gateway to foster the interest in learning of vocational school students in general subjects. In response to this, the researcher revised the title layout and chose a background image that is more contextual with the world of tourism

to strengthen the connection between the material "Substances and Their Changes" and the student's field of expertise.

Teachers' Responses to the IPAS Project

An analysis of teachers' impressions of the IPAS Project can be seen in Figure 3.

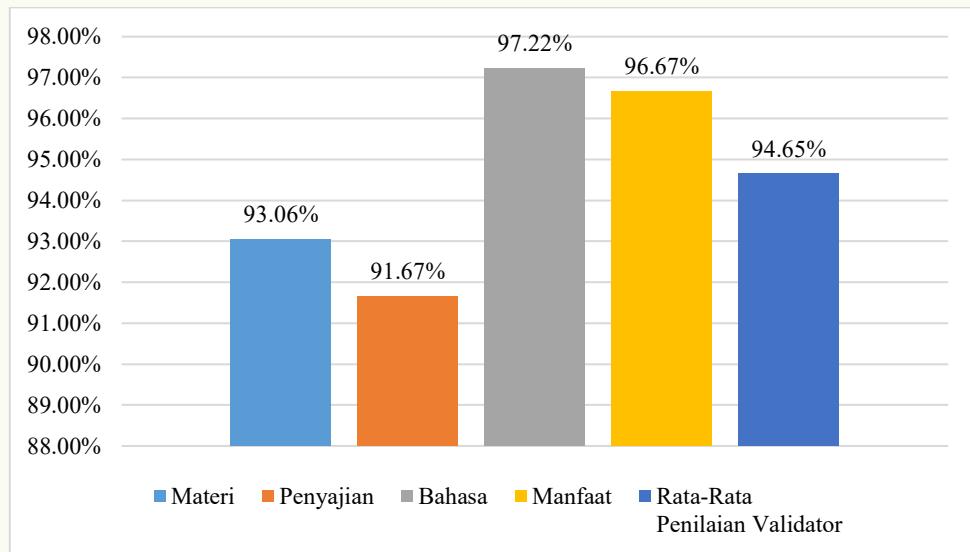


Figure 3. Teachers' Responses to the IPAS Project

Based on Figure 3. It is known that in the material aspect, an average percentage score of 93.06% was obtained, the presentation aspect obtained an average percentage score of 91.67%, the language aspect obtained an average percentage score of 97.22%, and the average benefit was 96.67%, The average percentage results of the four aspects of assessment of 94.65% were included in the very feasible category.

This finding is in line with the affirmation of Ni Luh Gede Karang Widiastuti (2021) that the contextual approach in science learning must touch daily reality to increase interest in learning in the Papua Tourism Vocational School and is in line with the research of Tiurlina Siregar et al (2025).

Scientific Literacy Analysis Using E-Modules Through PjBL's Approach to Substance Matter and Its Changes

Improving scientific literacy skills before and after using the e-module of the IPAS Project on Substances and Their Changes with the PjBL model can be seen in Figure 4.

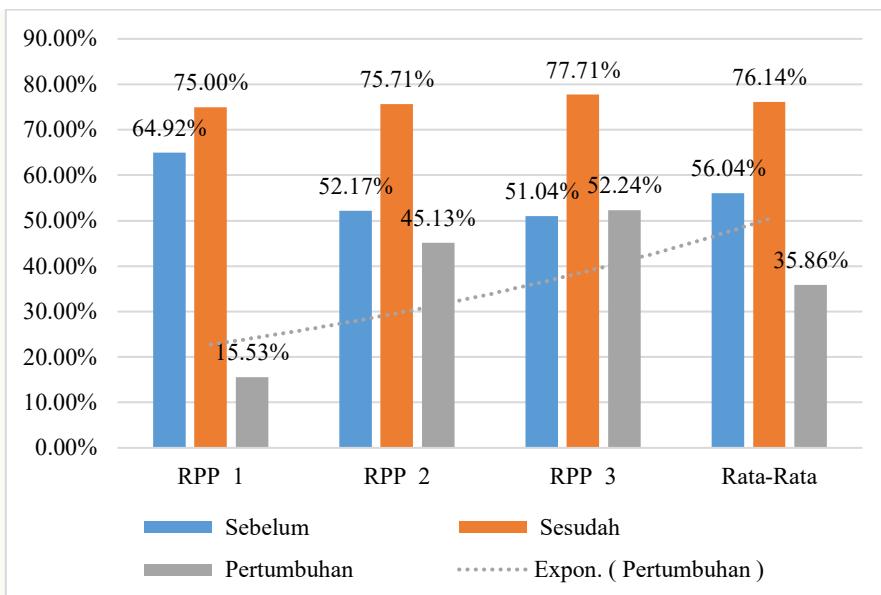


Figure 4 Scientific Literacy Assessment before and after using the E-Module

Based on Figure 4. It is known that students' understanding of scientific literacy has improved in every meeting. This is shown from the growth graph of an increase in RPP 1 by 15.53%, in RPP 2 by 45.13%, in RPP 3 by 52.24% with an average value increase in the three meetings of 35.86%. This increase in presentation is due to the increasing familiarity of students using e-modules and the PjBL approach to substance materials and the changes are easier and clearly understood.

4. CONCLUSIONS AND SUGGESTIONS

CONCLUSIONS

The use of the IPAS Project e-module through the PjBL approach to improve scientific literacy in substance materials and their changes in class X Hospitality A has increased by an average of 35.86%.

SUGGESTIONS

Teachers are advised to use this e-module as one of the media in the independent curriculum.

5. ACKNOWLEDGMENTS

The author expressed his gratitude for the cooperation of the head of the Master of Science Education Study Program FKIP Cenderawasih University with the Principal of the Papua Special State School of Tourism in this research.

BIBLIOGRAPHY

Abidin, Z., Karyono, H., & Rahayu, E. M. (2021). The effect of the Project-Based Learning approach and learning motivation on learning outcomes in productive subjects in vocational schools. *JIPI (Scientific Journal of Informatics Research and Learning)*, 6(1), 58–64. 64. <https://doi.org/10.29100/jipi.v6i1.1619>

Dianawati, E. P. (2022). Project-Based Learning (PjBL): A powerful solution for today's learning. Google Books.

Hidayat, A., & Prasetyo, B. (2021). The application of Project-Based Learning to improve the science learning outcomes of vocational school students. *Indonesian Journal of Science Education*, 9(3), 457–468

Hidayati, N., & Andriani, N. (2020). Development of e-modules through a multimedia approach for science learning. *Journal of Science Education Innovation*, 6(1), 11–18.

Kimball, F. (2019). Development of science e-modules through the PBL approach to improve critical thinking skills and science literacy. *Journal of Science Education*, 8(2), 125–134.

Ministry of Education and Culture. (2021). Project-Based Learning (PjBL) Learning Guidelines in the Independent Curriculum. Jakarta: Ministry of Education, Culture, Research, and Technology.

Ministry of Education and Culture. (2022). Independent Curriculum Learning and Assessment Guide. Jakarta: Directorate General of Early Childhood Education, Higher Education, and Higher Education.

Mulyadi, E. (2015). The application of the Project-Based Learning approach to improve the performance and learning achievement of physics students in vocational schools. *Journal of Technology and Vocational Education*. <https://www.academia.edu/download/89953685/6708.pdf>

Prastowo, A. (2015). Creative Guide to Making Innovative Teaching Materials. Yogyakarta: Diva Press.

Parwiti, E., Siregar, T., & Albaiti. (2024). Development of STEM-based thermodynamics e-modules integrated with problem solving to improve critical thinking skills and learning outcomes. *Journal of Science Education and Practice*, 6(1), 12–25. <https://ejournal.uncen.ac.id/index.php/JIPI/article/view/4058>

Purwanto, A. (2020). The effect of the use of interactive e-modules on students' learning motivation. *Indonesian Journal of Education*, 9(1), 23–30.

Rusmawati. (2023). Development of material learning modules and their changes using the PjBL strategy at SMK Negeri 8 Surabaya. *Journal of Vocational Education*, 13(2), 110–122. <https://jurnal.unipar.ac.id/index.php/ej/article/view/1318>

Setiawan, R., & Wicaksono, I. (2021). Interactive e-modules in science learning: Development and implementation. *Indonesian Journal of Science Education*, 9(2), 144–150.

Siregar, T., Karubaba, M., Siallagan, J., & Inggambar, M. M. (2023). Development of chemical e-modules based on Papua local wisdom on reduction and oxidation reaction materials to increase student learning outcomes. *Indonesian Journal of Education*, 5(1), 45–53. <https://ejournal.uncen.ac.id/index.php/JIPI/article/view/2409>

Sudjana, N. (2009). Assessment of the results of the teaching and learning process. Bandung: Remaja Rosdakarya.

Siregar, T., Yawan, F. S., & Samosir. C. R. (2025). E-module of contextual based chemistry in increasing learning activity on hydrocarbon compound material. *Indonesian Journal of Education*, 13(1), 45–54. <https://ejournal.uncen.ac.id/index.php/JIPI/article/view/4571>