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Development e-module on human reproduction system materials science-Islam integrated to improve science literacy and student learning outcomes

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Abstract

Low scientific literacy is due to the large amount of material being taught and not applying basic biological concepts to problems commonly encountered in the surrounding environment. The Islamic science integration approach, which was developed into teaching materials in the form of e-modules, needs to be applied because it places a variety of diversity in scientific disciplines (Islamist studies, Natural studies, Social studies, and Humanities). The research aims to develop and test an E-module's validity, practicality, and effectiveness based on Problem-Based Learning (PBL) Integrated Islamic Science Human Reproductive System Material to Improve Science Literacy and Student Learning Outcomes. The research and development model refers to a Branch consisting of ADDIE, namely the analyze, design, develop, implement, and evaluate stages. The data collection techniques used were questionnaires and validation sheets. The results of research on the effectiveness of e-modules show that e-modules are very valid in improving scientific literacy and student learning outcomes. Based on the N-gain calculation, scientific literacy is in the medium category with significant t-test results. The learning outcomes are in the high category with very significant t-test results. This research shows that the PBL-based e-module material on the science-Islam integrated human reproductive system can be developed and effectively used in learning activities.

Abstrak. *Literasi sains rendah disebabkan banyaknya materi yang diajarkan, kurang menerapkan konsep dasar biologi terhadap permasalah yang biasa ditemui di lingkungan sekitar. Pendekatan integrasi sains-Islam yang dikembangkan menjadi bahan ajar berupa e-module perlu diterapkan karena menempatkan berbagai keberagaman terhadap disiplin ilmu (Islamis-Studies, Natural studies, Social studies dan Humaniora). Penelitian bertujuan untuk mengembangkan, menguji kevalidan, kepraktisan, dan keefektifan e-module berbasis Problem Based learning (PBL) Materi Sistem Reproduksi Manusia Terintegrasi Sains Islam untuk Meningkatkan Literasi Sains dan Hasil Belajar Mahasiswa. Model penelitian dan pengembangan mengacu pada Branch terdiri dari ADDIE yaitu tahap analyze, design, develop, implement, dan evaluate. Tenik pengumpulan data yang digunakan berupa angket dan lembar validasi. Hasil penelitian terhadap keefektifan e-module menunjukkan bahwa e-module sangat valid dalam meningkatkan literasi sains dan hasil belajar mahasiswa. Berdasarkan perhitungan N-gain literasi sains masuk kategori sedang, dan hasil belajar masuk kategori tinggi dengan hasil uji-t yang sangat signifikan. Hasil penelitian ini dapat disimpulkan bahwa e-module berbasis PBL materi sistem reproduksi manusia terintegrasi sains-Islam dapat dikembangkan dan efektif digunakan dalam kegiatan pembelajaran.*

A. Introduction

The development of the 21st century is an era of education based on knowledge-based education, knowledge-based social empowerment, knowledge-based economics, and knowledge-based industry (Mukhadis, 2013). The 21st century is an era of technological development, carrying out a process of change in providing quality resources, producing superior seeds, and completely new demands for developing ways of thinking, concepts, and actions (Wijaya et al., 2016).

Education is oriented towards Islam education and education in general, which has six elements: educational tools, objectives, educational environment, students, basics, and educators (Rasyid et al., 2020). Education that integrates general subjects such as biology with the Islam religion in general or religious educational institutions, from primary education to tertiary education in Indonesia, is an absolute must (Suciati et al., 2022). Biological sciences, connected to religious knowledge foundations, are rarely applied in higher education. As a general science taught to students, biology still does not provide some perceptions of life that contain elements based on Islamic law. Biological knowledge in teaching healthy living behavior needs to be equated with religious knowledge to know the good and bad of maintaining the purity and health of the body. Biological knowledge, such as material on the human reproductive system, is also expected to be integrated in a science-Islam manner as an effort to maintain the health of reproductive organs and avoid understandings that are violated by religion.

The learning process carried out by teachers in schools, on average, does not master science knowledge about religious knowledge, so science integration is still challenging to implement (Zain & Vebrianto, 2017). An integrated approach to science and technology should be applied because it places a variety of diversity in scientific disciplines (Islamist studies, Natural studies, Social studies, and Humanities).

Science-Islam integration is a concept of understanding different perspectives based on decisions received by combining the results of various beliefs. According to Nurohmatin (2017), the role of the Al-Qur'an and science is to be able to provide concrete scientific answers to students. Education that is applied to improve the quality of the integration of science with the Al-Qur'an is expected to be no less in guiding students toward modern scientific progress.

Scientific literacy is an ability that supports students' learning and improves scientific skills, such as in biology. According to the Kementrian Pendidikan dan Kebudayaan (2017), scientific literacy is the knowledge that can identify questions, master new knowledge, describe scientific phenomena, and draw conclusions based on existing facts. According to Sumanik et al. (2021), in current developments, students often experience changes in their interest in learning, curiosity, and lack of ability to solve problems, resulting in low scientific literacy. Several researchers revealed that the expected literacy still has difficulties handling scientific evidence and making decisions on issues based on social science (Hopfenbeck et al., 2018).

Based on the needs analysis results, scientific literacy in students' FISHEMAN courses is known to be low for each indicator. The percentage of scientific literacy indicators for human reproductive system material from 30 students reached 50.00%, assessed from 100%, which indicates the poor category. The indicator for explaining phenomena scientifically averages around 48.89%, which means the poor category. The average result on interpreting data and scientific evidence indicators is known to reach 45.00%, which indicates the poor category. The average indicator for evaluating and designing scientific investigations is 56.67%, assessed from 100%, which shows the results in the sufficient category. Low literacy ability is proven based on the test questions; the percentage results show that students still lack scientific literacy, which covers every human reproductive system material sub-chapter.

The results prove that several factors cause low scientific literacy: students have difficulty understanding basic concepts in the material presented by lecturers, and there is a lot of material taught to students; apart from that, explanations regarding basic biological concepts are not applied to problems commonly encountered in the surrounding environment. Indicators to explain phenomena scientifically need to be taught further by using more effective teaching materials. This statement is a suggestion for the learning process so that the teaching materials used by students are not just power points presented by each group. Teaching materials that support the learning process can increase student interest in interpreting data more efficiently and clearly.

Improving student learning outcomes can be combined through learning design and empowering sustainable scientific literacy knowledge with a cognitive mindset. Lecturers are expected to be able to train students in constructive learning activities by providing questions regarding phenomena in the environment. Increased scientific literacy is expected to improve student learning outcomes through various indicator questions on the human reproductive system material. According to Nurohmatin (2017), Islamic values can combine scientific knowledge without eliminating elements from both sciences. The integration of Islamic values is packaged in the form of questions by giving

problems related to the Islamic perspective without changing competency standards.

The teaching materials lecturers provide are sometimes teaching resources that students rarely use. Teaching materials support learning outside of learning, guide students, and determine learning methods based on lectures, discussions, etc., by competency standards. According to Kokasi (2021), the teaching materials used by lecturers strive to have freedom in selecting, developing, and presenting materials, especially teaching materials that can be used in various places. Teaching materials such as modules provide learning tools in printed or electronic form that are arranged systematically (Fahrurrozi & Mohzana, 2020). Based on the analysis of lecturers' needs, it is known that the teaching materials usually presented to students when studying FISHEMAN about the human reproductive system are printed books. The analysis of student needs revealed that they had also used other teaching materials, including electronic books, handouts, and electronic modules.

One of the keys to using PBL is the information and problems obtained in learning (Rizki & Adlini, 2022; Rosyid et al., 2023). The PBL is taught to students to deal with problems related to the context of everyday life, problems that are improved with knowledge stored and studied previously (Sani, 2014). PBL is a learning model that can train students' scientific literacy skill domains through investigation and analysis activities (Fauziah et al., 2018), and learning processes related to social issues positively impact aspects of scientific literacy competence (Rubini et al., 2019). A learning solution that can overcome the problem-solving process and train scientific literacy skills is a balanced PBL learning model (Qomariyah et al., 2019).

The science-Islam integrated module has previously been researched and developed in previous research. It is known that the science-Islam integration module has several weaknesses, including not discussing one competency unit in its entirety, complete mastery and self-contained completeness not being found, and not containing components implemented by the Directorate of Educational Personnel (Nadya, 2023). The hope is that the integrated science-Islam module will allow students to study the material concepts of the human reproductive system with a balance of science and religion as an umbrella of knowledge or a source of scientific inspiration. Important material that needs to be understood further, such as the menstrual cycle, pregnancy and childbirth, ejaculation and erection, as well as abnormalities in the reproductive system, have entered puberty. The reproductive system material in the module will be balanced with some knowledge of Islamic law as additional information integrated with biological concepts to increase insight and awareness in maintaining reproductive health.

Teaching materials that can support learning process activities are teaching materials that need to be applied and trained to students. Teaching materials applied to electronic teaching materials must be used and then applied to deepen knowledge in the science-Islam integrated human reproductive system material. The learning style that involves problem-based learning is adapted to the student's perspective to find engaging image media in the learning material. As a result of this development, it is hoped that students will be able to pay close attention to the material through discussions, memorize it, and provide evaluations based on the identification results. In developing this e-module, researchers intend to test the validity, practicality, and effectiveness of the PBL-based E-module on integrated science-Islam human reproductive system material to improve scientific literacy and student learning outcomes.

B. Material and method

The research and development model used in this research is the ADDIE learning model, which refers to Branch (2009). The preliminary study is a product development concept applied as a performance-based learning development. The guiding framework is expected to help teachers in the learning process and make it easier for students to understand and achieve learning goals.

The parameters used to determine performance gaps during the learning process are student and lecturer needs analysis questionnaires. The student and lecturer response questionnaire includes learning models, methods, media and teaching materials, scientific literacy questions, and student learning outcomes. Data collection procedures were conducted using the analysis, design, development, implementation, and evaluation stages. The research design uses a pre-experimental design with one group pretest post-test. Data collection techniques include validity sheets, student response questionnaires, and pretest and post-test questions. The expert validation sheet tested by the validator consists of aspects of PBL characteristics: Attractiveness, E-module Ease of Use, E-module Ease of Understanding, and Sophistication of E-module Sources. Aspects of e-module development based on student responses include attractiveness, ease of use, understanding, and contemporary sources. The e-module practicality test was assessed based on three stages: individual trials, small group trials, and field trials. Test the effectiveness of the e-module through pretest and post-test scores to measure scientific literacy and student learning outcomes in the form of gain scores. Data resulting from validation by experts were analyzed using mean score analysis. The formula is written like Formula 1.

$$V = \frac{Tse}{Tsh} \times 100\% \text{.....Formula 1}$$

Information:
V = Percentage of validity
Tse = Total empirical score (score for completing the validation questionnaire)
Tsh = Maximum total score (maximum score from completing the validation questionnaire)

Data from the pretest and posttest scores to assess effectiveness were analyzed using the gain score analysis technique (Hake, 1999) with a formula written as Formula 2. Scientific literacy and student learning outcomes were identified using high or low criteria based on gain, namely the classification in Table 1.

$$\text{gain} = \frac{\text{score posttest} - \text{score pretest}}{\text{score maximum} - \text{score pretest}} \text{ ..... Formula 2}$$

Table 1 Gain score classification

Category	Decision
(<g>) ≥ 0,7	g-high
0,3 ≤ (<g>) < 0,7	g-medium
(<g>) < 0,3	g-low

(Source: Hake, 1999)

C. Results and discussion

The results of developing a PBL-based E-module on the Islamic-science integrated Human Reproductive System material have been validated by material experts, teaching materials, and biology education practitioners. The practicality of the e-module has been tested on students individually, in small groups, and in large groups. The effectiveness of the e-module was determined through pretest and posttest.

Validity of the PBL-Based E-module on Science-Islam Integrated Human Reproductive System Material

The e-module development was tested for validity by material experts, teaching materials, and biology education practitioners. Validation results from teaching materials experts show that RPS and SAP are appropriate and very valid to be applied to learning with percentages of 97.8% and 98.5%. The aspects assessed for question validation are construction, material, and language. The results of the validation of questions from material experts show that the questions are very valid, with a percentage of 89.1%. Empirical validation results show that all questions are valid and reliable.

The aspects assessed for validation of the PBL-based e-module by material experts are the suitability of the material description with CPMK and Sub-CPMK, Human Reproductive System material, and presentation support (BSNP, 2014). The results of material expert validation show that the average value is 90.48%, which shows that the e-module is in the very valid category. A summary of the data from validation results by material experts is presented in Table 2. The percentage of validation results from material experts, if it reaches 100%, shows that the PBL-based E-module material on the science-Islam integrated human reproductive system is in a very valid group for use.

Aspects assessed by teaching materials experts are the completeness of e-module components, e-module design, relationship between e-module content and the PBL learning model, appropriateness of language, and suitability of e-module. The validation results of the PBL-based e-module show that the average value is 100%, which shows that the e-module is very valid. A summary of validation data by teaching materials experts is presented in Table 3.

Aspects assessed by biology education practitioner validators include the completeness of the content, the ease of the e-module to use, the ease of the e-module to understand, and the up-to-dateness of the e-module. The validation results of biology education practitioners received an average score of 90.68%, which shows that the PBL-based e-module material on the science-Islam integrated human reproductive system is very valid. Regarding the ease of understanding of the e-module, it is in the valid category because the image structure is unclear. The material should be more complete with the development of embryos, sperm, and others and summarized with a better understanding. A summary of validation data by biology education practitioners is presented in Table 4. The e-module, validated by material experts, teaching materials experts, and biology education practitioners, contains several suggestions and comments to improve it into an appropriate teaching materials product. Presentation of product use, completeness of material on the human reproductive system, and providing images and spelling of incorrect writing so that it needs to be completed and added with correct and clear sentences.

Teaching materials in the form of an E-module are said to be good if the content validity of the teaching materials is of good quality and focuses on the material or theoretical solid rationale; apart from that, the various components must be consistently related to each other (Plomp & Nieveen, 2013). Validation tests by material experts are expected to obtain validation or approval from material expert validators regarding the suitability of the material contained in the E-module to needs (Surahman & Surjono, 2017). The material is adjusted to the definitions that apply in the field of Biology accurately; the breadth of material presented is by current developments in biological science, and images and videos can support the content of the material by reality so that it is efficient to increase student understanding (BSNP, 2014). According to

previous research, the E-module material on the human reproductive system integrated between science and Islam also helps generate ideas regarding the importance of the Islamization of science, making fiqh the basis for thinking. The E-module increases students' knowledge regarding the construction of scientific-Islamic integrated human reproductive system material thinking by including aspects of natural Islamic science, social science, and humanities as aspects of the cultural context of the Indonesian nation (Amin, 2020). Teaching materials in the form of e-modules are validated and then revised, as in Figure 1. The development of electronic modules can be used as a medium that makes it easier for students to study and understand the material independently. Electronic learning media is more effectively applied in learning activities than regular learning (Ahsan, 2016). According to Husna et al. (2020), the product being developed can be considered valid if the assessment results from expert validators show that the product validity level is in the minimum feasible category of around 61-80. Other research also indicates that research that develops e-modules with science-Islam integration can meet valid criteria (Diani et al., 2018).

The E-module that has been developed needs to be revised on the cover to make it more attractive. The developed E-module needs to be provided with images that match the material's content so that it can provide a more accessible and more precise understanding. According to Putri et al. (2018), the module used as a good teaching material must show the appearance, design color, type of text size, and language that makes students interested in reading. According to Krissandi & Rusmawan (2015), the suitability of learning outcomes using learning media can help students learn and achieve learning goals. Prasetya (2021) stated that with these resources, using e-module teaching materials can help students learn independently and access materials without being tied to a place and change students' views to feel more comfortable.

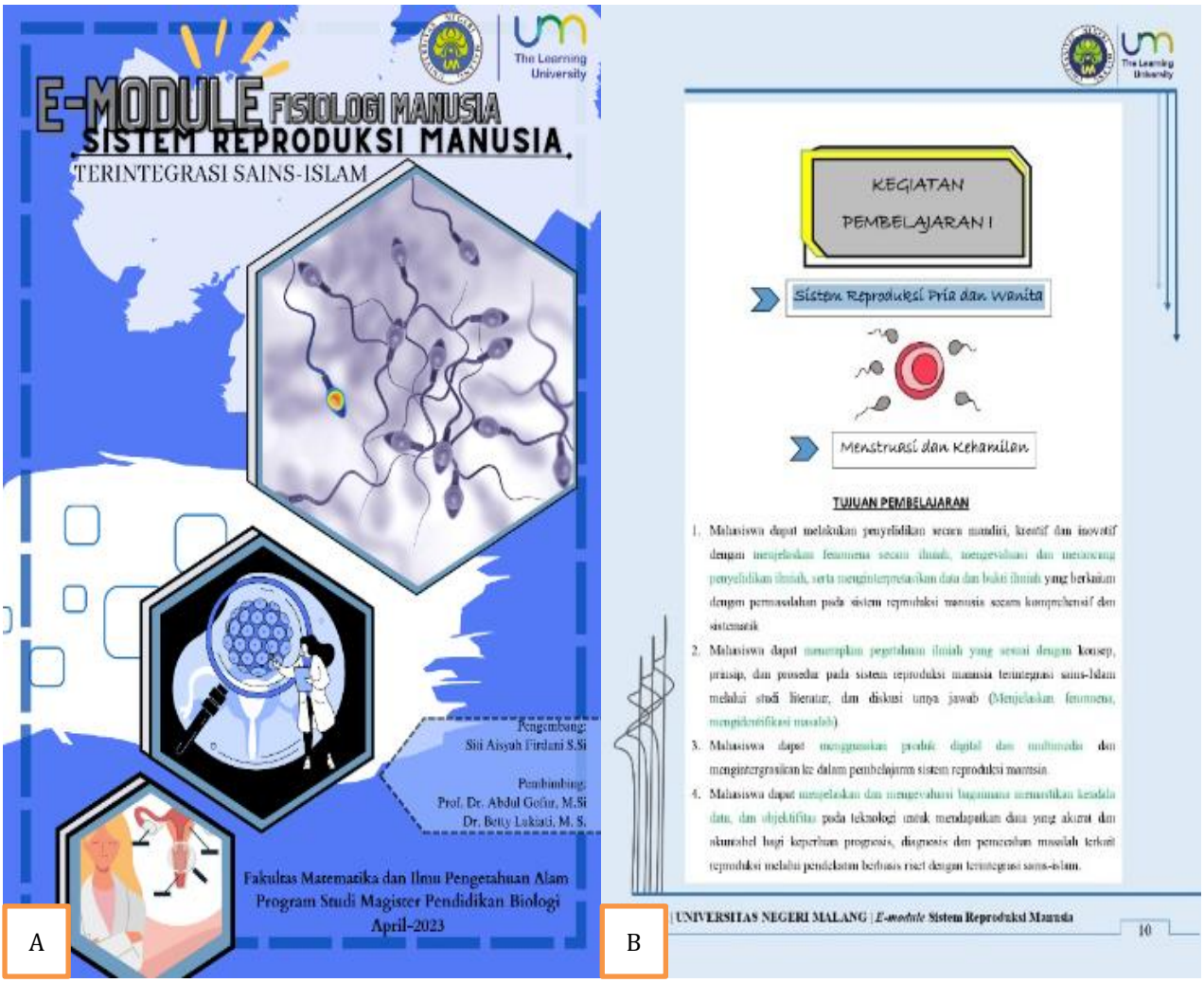

Figure 1 Islamic-science integrated human reproductive system e-module cover (A) and one of contents (B) (in Indonesian)

Table 2 Summary of validation results data by material experts

No.	Characteristics of PBL Based E-module	Value (%)	Description
1.	Conformity of material description with CPMK and Sub-CPMK	91.43	Very valid
2.	Human reproductive system material	93.33	Very valid
3.	Supporting presentation	86.67	Very valid
Mean		**90.48**	**Very valid**

Table 3 Summary of validation results data by teaching material experts

No.	Characteristics of PBL Based E-module	Value (%)	Description
1.	Completeness of e-module components	100	Very valid
2.	Eligibility of content	100	Very valid
3.	Language eligibility	100	Very valid
Mean		100	Very valid

Table 4 Summary of validation results data by biology education practitioner

No.	Characteristics of PBL Based E-module	Value (%)	Description
1.	Completeness of contents	97.14	Very valid
2.	E-module ease of use	100	Very valid
3.	E-module ease to understand	95.56	Very valid
4.	E-module source updates	70	Valid
Mean		90,68	Very valid

The Practicality of PBL-Based E-module on Integrated Science-Islam Human Reproductive System Material

Individual trials were shown to 3 Biology students who had taken the Animal and Human Physiology course on the Human Reproductive System. The individual test results have an average score of 90.53% in the very practical category. Small group trials were given to 10 students who had taken Animal and Human Physiology courses, especially material on the Human Reproductive System. The small group test results had an average of 92.91%, with the category being very practical. The field trial was intended for around 20 active students who had already taken Animal and Human Physiology courses on the Human Reproductive System. The results of the field trials had an average score of 89.00%, which is included in the very practical category. A summary of the trial results data is presented in Table 5. The practicality of developing a PBL-based e-module on integrated science-Islamic human reproductive system material is also given to students when they have implemented it. The average result in the student response questionnaire was 97.56% (very practical category). A summary of student questionnaire responses is presented in Table 6.

Table 5 Summary of small group trial results data

No.	Characteristics of PBL-based *E-module*	Individual Trial		Small Group Trial		Large Group Trial	
		Value (%)	Information	Value (%)	Information	Value (%)	Information
1.	Attractiveness	91.43	Very Practical	97.14	Very Practical	90.71	Very Practical
2.	E-module ease of use	95.83	Very Practical	94.50	Very Practical	87.50	Very Practical
3.	E-module ease of understanding	88.89	Very Practical	100.00	Very Practical	92.78	Very Practical
4.	Sophistication of e-module sources	86.67	Very Practical	80.00	Very Practical	85.00	Very Practical
Mean		**90.53**	**Very Practical**	**92.91**	**Very Practical**	**89.00**	**Very Practical**

Table 6 Summary of student response questionnaire results data

No.	Development Products	Value (%)	Information
1.	Attractiveness	90.23	Very Practical
2.	Ease of use	100	Very Practical
3.	Ease of understanding	100	Very Practical
4.	Updated sources	100	Very Practical
Mean		**97.56**	**Very Practical**

The practicality of the PBL-based e-module on integrated science-Islamic human reproductive system material was measured through response questionnaires from biology education practitioners, student response questionnaires, and observations of syntax implementation. E-modules tested as teaching

materials can be considered practical if they are consistent with the learning objectives and the learning process (Plomp & Nieveen, 2013). According to Hill et al. (2015), modules developed online help students' understanding of learning because they are practical and easy to use. According to Erna et al. (2021), indicators of ease of use of teaching materials can be assessed from student responses. The e-module developed can be used repeatedly, is easy to operate the teaching material product, and can be used to achieve learning objectives. Teaching materials in e-modules with good presentation increase student learning style facilities (Saraswati et al., 2019). Presenting material that is arranged coherently, complemented by adding images, video, and audio, can attract students' attention to learning (Colasante & Douglas, 2016 & van Alten et al., 2019).

The Effectiveness of a PBL-Based E-module on Integrated Science-Islam Human Reproductive System Material to Improve Scientific Literacy and Student Learning Outcomes

The observations showed that the learning syntax had been implemented well, starting from pre-learning, initial, core, and closing activities. Learning activities for each group include conducting investigations and seeking information balanced with the problems in working on the LKM. The effectiveness of a PBL-based e-module in training scientific literacy and student learning outcomes can be determined through pretest and posttest scores. The average N-gain score for scientific literacy is around 0.70%, included in the medium effectiveness criteria. The calculation of pretest and posttest scores with the results of the N-gain score for scientific literacy is presented in Table 7. The average N-gain score for student learning outcomes based on indicators is around 0.80%, which is included in the criteria for high effectiveness. The calculation of pretest and posttest scores and the N-gain scores for student learning outcomes is presented in Table 8.

The results show that the e-module is effective in increasing scientific literacy. The results obtained through a paired t-test with a p-value of 0.000 < α 0.005 show a difference in scientific literacy before and after using the e-module. The results of the analysis of the effectiveness of the PBL-based E-module on integrated science-Islamic human reproductive system material are also known to be able to improve student learning outcomes. These results were obtained through paired t-test results with a p-value of 0.000 < α 0.005, showing the difference between student learning outcomes before and after using the e-module. Affective learning results show that students positively respond to health and care by studying the human reproductive system.

The effectiveness of using e-modules on science-Islam integrated human reproductive system material needs to be supported by student enthusiasm in reading and identifying problems. According to Finneran (2017), reading is an activity that involves reasoning processes, such as analyzing, interpreting, solving problems, and communicating scientific ideas. Frequently reading students can improve their scientific literacy and assess problems quickly based on accurate assumptions, evidence, and truth. Reading and identifying problems are mutually beneficial activities in improving indicators to explain phenomena scientifically (OECD, 2017). E-modules used to build scientific literacy should be developed based on specific criteria to get quality results. Quality material meets quality aspects such as validity, practicality, and effectiveness (Sani, 2014).

Table 7 Calculation of N-gain score for scientific literacy

No.	Indicator	Pretest Value	Posttest Value	N-gain	Description
1.	Explain phenomena scientifically	53.00	81.76	0.61	Medium
2.	Evaluate and design investigations	50.15	81.50	0.63	Medium
3.	Interpret scientific data and evidence	50.75	93.45	0.87	High
Mean		**50.45**	**85.59**	**0.70**	**Medium**

Table 8 Calculation of N-gain score for student learning outcomes

No.	Indicator	Pretest Value	Posttest Value	N-gain	Description
1.	Cognitive learning outcomes	42.11	82.00	0.66	Medium
2.	Psychomotor learning outcomes	40.00	93.86	0.93	High
Mean		**41.06**	**87.93**	**0.80**	**High**

The PBL-based e-module, implemented through student learning outcomes, can identify complex problems in the real world, manage conflict, make decisions independently, and develop high-level thinking skills (Ngang et al., 2014). The increased learning outcomes after using the PBL-based e-module on the science-Islam integrated human reproductive system material align with other research results. According to Muspiroh (2013), Improving student learning outcomes is one of the goals of science-Islam integration in biological science learning because it can strengthen cognitive, affective, and psychomotor domains if implemented in the learning process. Learning outcomes integrated with

science and Islam can change low understanding and improve student character (Ali et al., 2015; Pattaro, 2016; & Munir, 2016). Students' cognitive learning outcomes can increase using the PBL learning model, which applies their knowledge to real-life situations (Cordeanita et al., 2019). Teaching materials that provide ease of use, attractive appearance, and communicative discussion can also significantly increase motivation and learning outcomes (Pramana et al., 2020).

D. Conclusion

The conclusion of the research results on the development of a PBL-based e-module on integrated science-Islamic human reproductive system material to improve scientific literacy and student learning outcomes is that the E-module developed has been declared valid, practical based on expert validation results and trial results so that it can be used to support learning material about the human reproductive system in the Animal and Human Physiology course. The e-module developed effectively improves scientific literacy and student learning outcomes on test subjects.

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