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Development of Digital Literacy-Based Project Based Learning Assessment Models to Improve High School Students' Creative Thinking Abilities

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Abstract: The use of technology and interactive media in learning is crucial for developing essential information technology and media skills in today's digital era, fostering digital literacy – the ability to understand, use, analyze, evaluate, and participate in the digital world effectively and responsibly. The purposes of this research are to validating a digital literacy-based project-based learning model assessment and enhancing students' digital literacy and creative thinking in high school biology. Using a development research approach and the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), 137 high school students in Poso Regency were sampled. The assessment tools, including observation sheets and rubrics, along with creative thinking tests, demonstrated validity (sig value < 0.05) and reliability (R > 0.60). Implementation revealed excellent digital literacy (86%), good creative thinking (75%), and a moderate improvement (N-gain = 0.68). The assessment's validity and reliability, confirmed through expert and field trials, support its applicability in high school biology learning.

Keywords: Assessment development; Creative thinking; Digital literacy; High school students; Project based learning

Introduction

Increasingly complex challenges of 21st-century life. 21st-century learning integrates technology, 21st-century skills (such as critical thinking, creative, collaborative, and communication skills), and innovative learning methods. The main goal of 21st-century learning is to prepare students to develop the skills needed to overcome future challenges and become productive and responsible global citizens. Skills that are considered important in 21st-century learning are information and media technology skills. The use of technology and interactive media is an important element because students can develop the information technology and media skills needed in today's digital era.

The concept of digital literacy is increasingly widespread in the 21st century. Increasing demands from the employment sector for individuals to be digitally literate have prompted targeted interventions and innovations from the education sector (Reddy et al., 2023; Zamista & Azmi, 2023) . Digital literacy is defined as the ability to understand, use, analyze, evaluate and participate in the digital world effectively and responsibly (Ali et al., 2023; Polizzi, 2020). Innovative digital literacy is integrated into current and future educational frameworks and models for teachers to narrow the digital literacy gap and prepare graduates to be ready to enter the world of work (Reddy et al., 2023). The digital era is an era of technological conversion which is characterized by the migration of activities to paperless, operating systems, internet networks, applications and cloud systems, to be effective, efficient, accurate and productive (Ibda et al., 2023). Digital literacy is not just about how to use hardware or

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software, but also about how to use information and technology effectively to achieve learning goals.

Facts found in the field show that schools, especially in Poso Regency, still lack attention to digital literacy. Biology learning still focuses on traditional learning which emphasizes reading, writing and memorizing so it does not pay attention to the importance of digital literacy as a skill needed today. Another problem is that not all students have access to technological devices such as computers or smartphones, and unequal access results in gaps in digital literacy. The lack of curriculum development that can be seen in some schools does not include digital literacy as part of the curriculum, so students do not have the opportunity to learn the skills needed to function well in the digital world. For this reason, a strategy is needed so that students can increase digital literacy in learning, one of which is through implementing the Project Based Learning model.

Project-based Learning (PjBL) is learning that is focused on projects or assignments that require students to develop understanding and skills in a particular context so that they can obtain and utilize information effectively. The PjBL model itself is a learning model that prioritizes learning through projects or tasks that are meaningful for students so that they are involved in knowledge construction and gives students the chance to perform experiments in groups and investigate material in a variety of meaningful ways for them. Students engage in groups through PjBL to complete tasks that have been planned (Santos et al., 2023; Astriani et al., 2023). Students are expected to be able to solve problems independently and creatively and be able to develop social, cognitive and emotional skills in this model. This model aims to actively involve students during the teaching and learning process and increase student understanding by creating, utilizing, and selecting models to describe, explain, predict and control physical phenomena. Therefore, teachers do not require students to memorize teaching materials for their subjects but acquire the required skills by implementing appropriate teaching models in the classroom (Muzana et al., 2021). An efficient teaching strategy that emphasizes students' ability to think creatively, solve problems, and collaborate with peers to acquire and apply new information is the project-based learning model (Doyan et al., 2023).

This research is crucial to develop as it will sharpen students' digital literacy skills as today's lives are increasingly dependent on technology and the digital environment. Education today is increasingly integrating technology into the learning process. Students who have digital literacy skills can more effectively use online resources, participate in technology-based learning, and understand information critically. Digital literacy supports innovation and creativity. Students who can adapt to new technologies are more likely to develop new ideas, solutions, and innovative products.

This research was carried out to develop an assessment that matches the characteristics of PjBL so that it can be used by teachers to measure students' ability to master learning material taught through projects using digital technology and can also improve students' creative thinking abilities. According to Sternberg, creative thinking is an individual's ability to produce ideas or ideas that are new, original and useful in a particular situation or problem. This ability involves complex thought processes, such as combining existing ideas, changing points of view, and finding new relationships between existing concepts (Sternberg RJ, 1998). It was further explained that creative thinking is a process of understanding difficulties, problems, information gaps, and inconsistencies; formulating the problem clearly; formulating a hypothesis about deficiencies; examining the hypothesis and possibly revising it and reexamining or redefining the problem, and finally communicating the results, which aims to solve a problem (Sitorus et al., 2019; Kurniahtunnisa et al., 2023). Improving creative thinking abilities can be done through assessments specifically designed to measure students' creative thinking abilities in the form of tests. This test can measure various aspects of creative thinking, such as fluency of ideas, originality of ideas, and elaboration of ideas.

The purpose of the assessment is to obtain accurate and valid information about student achievements during the learning process. Therefore, the assessments that will be developed through the PjBL model must reflect students' abilities in digital literacy. Through the development of a digital literacy-based PjBL assessment model, students can learn about digital literacy actively and challengingly, can hone their creative thinking skills, and at the same time teachers receive useful feedback to improve their abilities in digital literacy and creative thinking. In addition, effective assessments help teachers to evaluate student progress in achieving learning goals and develop better learning strategies in the future. This research aims to 1) find out the validity of digital literacy-based project-based learning model assessments and 2) describe students' digital literacy and increasing students' creative thinking abilities abilities in biology learning in high school.

Method

Research Design

This research is development research that aims to develop a project-based learning model assessment based on digital literacy using the ADDIE model design, namely Analysis, Design, Development, Implementation, and Evaluation (Yu et al., 2021) which can be seen in Figure 1.

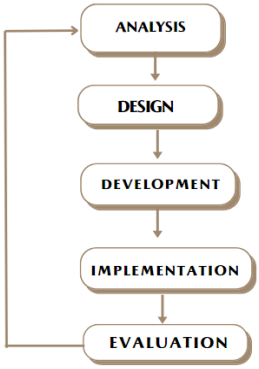


Figure 1. ADDIE model development research flow chart

Location and Time

This research was carried out in four high school schools. The schools are in three sub-districts in Poso Regency. The total sample is 137 class XI students taken by purposive sampling. This research was carried out from July to October 2023.

Development Stages

First, the analysis stage: student conditions, biology mastery levels, and learning needs were identified. The assessment tools were developed by analyzing curriculum, learning resources, student worksheets, and assessment requirements.

Second, the design stage: involved planning a digital literacy-based Project-based Learning (PjBL) model assessment using observation sheets, rubrics, and creative thinking test questions to cover learning outcomes.

Third, the development stage: created modified, and tested assessments. Trials were conducted with experts on assessment instruments and learning tools, as well as experts on biology materials, to measure device validity.

Fourth, the implementation stage: included limited and wide-scale trials at selected high schools to test the assessment product.

Fifth, the evaluation stage: an ongoing step, assessed the product and process quality before and after implementation. Revisions were made to improve aspects for subsequent stages. The final evaluation assessed the suitability of assessments for biology learning activities.

Data Collection Technique

Data collection uses a project-based learning model assessment instrument based on digital literacy that has been developed. Data on the development of assessment tools was obtained using assessment sheets and user responses in the form of questionnaires.

Data Analysis Technique

Expert Validation

Instrument validation was carried out through expert judgment by 3 experts. 2 material experts who were course lecturers and 1 learning assessment expert in the biology education study program. The Aiken item validity index formula was used to obtain validity data. The instrument is declared valid if the Rater Agreement Index value with V value is ≥0.75 (Balaguer López et al., 2022).

Furthermore, the reliability of the assessment tool assessment sheet uses Interrater Reliability to build trust and confidence in research findings, namely Intraclass Correlation Coefficients (ICC) via the SPSS ver.21 application. The measuring instrument has adequate stability if the ICC between measurements is >0.50, and high stability if the ICC between measurements is ≥ 0.80 (Zahra et al., 2023).

Field Validation

Validity in field trials was measured using the product moment formula via SPSS ver. 21 apps. These criteria are used to decide that the assessment being developed is declared valid if the r_{count} value > r_{table} and sig value <0.05, while the reliability value uses the Cronbach-Alpha formula using the SPSS ver.21 application. The test reliability testing criteria is if the Croncbach-Alpha value is > 0.60 Digital Literacy and Creative Thinking Ability Students' digital literacy abilities and creative thinking abilities indicators measured was fluent, flexible, original, detailing and evaluating skills are calculated using a percentage formula (Sugiyono, 2017).

The categories of digital literacy skills and creative thinking abilities refer to (Gronlund, 1996) which has been modified with the following criteria :

Table 1. The Categories of Digital Literacy Skills and Creative Thinking Abilities

Interval	Category
85% ≤ N	Very good
75% ≤ N < 85%	Good
60% ≤ N < 75%%	Good enough
40% ≤ N < 60%	Not good
< 40%	Badly

The test's discrimination power and degree of difficulty are measured in order to assess the test's quality. SPSS Ver.21 was used for the analysis. According to (Arikunto, 2013), the difficulty index is calculated if it is greater than 0.3 and has a minimum middle category. Next, the test's discrimination power is evaluated using the Arikunto criterion, where the minimum suitable category is found in the discrimination power index.

Improving students' creative thinking abilities is measured using the N-gain by (Hake, 1999) formula with the following criteria:

Table 2. Criteria for Improving Creative Thinking Abilities

N-Gain Score	Category
$g \geq 0.70$	High
$0.30 \leq g \leq 0.70$	Middle
$g < 0.30$	Low

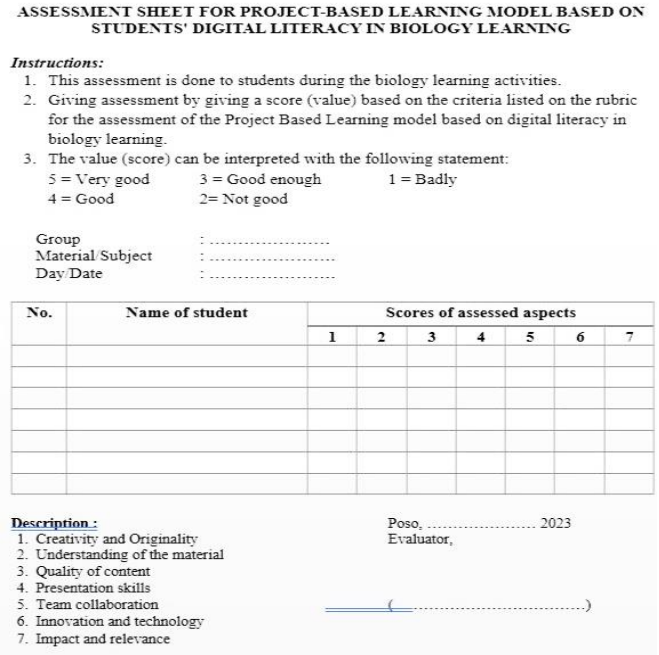
Improving students' creative thinking abilities is said to be good if the improvement category is at least middle.

Result and Discussion

Results of assessment product development

In this research, two assessment products were produced, namely digital literacy-based project based learning model assessment in the form of observation sheets and rubrics, and creative thinking ability test questions. The result of the assessment product in Figure 2 is used to assess digital literacy skills in biology learning which includes: Creativity and originality, namely the extent to which the project contains creative elements and original ideas in a digital literacy approach. Understanding of the material, namely the participant's ability to understand relevant digital literacy concepts use reliable references and be able to apply them in projects. Quality of Content, namely the quality of the content presented in the project, including information accuracy, clarity and depth of understanding. Presentation skills, namely students' ability to present projects in a clear, structured and interesting way using appropriate digital tools. Team collaboration, namely the ability of participants to work together, communicate and contribute effectively to the team. Innovation and Technology, namely the use of new or innovative technology and digital tools in relevant projects. Impact and relevances, namely the extent to which this project has a positive impact in increasing digital literacy and its relevance in the subject matter presented.

The digital literacy skills assessment sheet product through the PJBL model in biology learning is presented in Figure 2.



ASSESSMENT SHEET FOR PROJECT-BASED LEARNING MODEL BASED ON STUDENTS' DIGITAL LITERACY IN BIOLOGY LEARNING

Instructions:

1. This assessment is done to students during the biology learning activities.
2. Giving assessment by giving a score (value) based on the criteria listed on the rubric for the assessment of the Project Based Learning model based on digital literacy in biology learning.
3. The value (score) can be interpreted with the following statement:
   5 = Very good 3 = Good enough 1 = Badly
   4 = Good 2= Not good

Group : .....
Material/Subject : .....
Day/Date : .....

No.	Name of student	Scores of assessed aspects						
		1	2	3	4	5	6	7

Description :
1. Creativity and Originality
2. Understanding of the material
3. Quality of content
4. Presentation skills
5. Team collaboration
6. Innovation and technology
7. Impact and relevance

Poso, ... 2023
Evaluator,

(.....)

Figure 2. Assessment design of project based learning model based on digital literacy

Furthermore, the creative thinking ability test questions as a result of the development consist of 5 essay test questions in biology learning for class XI high school on movement system material as presented in Table 3.

Table 3. Creative Thinking Ability Test Questions on Movement System Material

Types of creative thinking ability	Questions
Fluency	Humans can move and carry out activities, such as walking, running, dancing and so on. The ability to perform body movements in humans is supported by a movement system, such as the skeleton (bones), joints and muscles
Flexibility	Make a schematic diagram of the human skeleton using the words below: skull - lower limbs - axial skeleton - upper limbs - upper arm bones - human skeleton - femur - appendicular skeleton – spine.
Originality	When someone exercises excessively, the muscles will experience fatigue, causing this to occur muscle cramp. What is the mechanism for muscle cramps? An accident caused one of Andi's arms to be amputated. This caused Andi to lose one of his limbs ?

Types of creative thinking ability	Questions
Elaboration	Vitamin D deficiency in children will result in impaired bone growth, causing the legs to bend (leg O and leg X).
Evaluation	What actions should you take if you experience something like this?

Validity and Reliability

Expert Validation

The assessment sheet is an instrument used to assess students' digital literacy abilities through a project-based learning model, while the rubric is a guide for giving scores to students' digital literacy abilities. The expert validation results are presented in Table 4.

Table 4. Validation Results of Observation Sheets and Digital Literacy-based PJBL Model Assessment Rubrics

Indicator	Validity
Instruction	1
Scope	1
Presentation	0.92
Language	1
Communication	0.92

Validation of the project-based learning model assessment sheet product based on digital literacy and the rubric used is content validity obtained from expert judgment. The validity values obtained ranged from 0.92 -1 as listed in Table 1. The results of expert validation of the creative thinking ability test questions are found in Table 5.

Table 5. Expert Validation of Creative Thinking Ability Test Questions

Indicator	Validity
Content	0.92
Construction	1
Language	1

Based on Table 4, it is found that the thinking ability test questions produced are very valid because the V value is > 0.75.

Validation in Trials is Limited

Validation results from limited trials of assessment sheets and rubrics for project-based learning models based on digital literacy were carried out by implementing them in the biology learning process on movement systems material, where data was obtained as presented in Table 6.

Table 6. Results of Limited Trial Validation of Observation Sheets and Digital Literacy-based PjBL Model Assessment Rubrics

Indicator	Sig value
Creativity and originality	0.04
Understanding of material	0.00
Quality of content	0.00
Presentation skills	0.00
Team collaboration	0.00
Innovation and technology	0.00
Impact and relevance	0.01

Based on Table 6, it is found that the validity calculation results obtained a sig <0.05, thus it can be concluded that the assessment developed has been declared valid. Furthermore, the results of the validation of creative thinking ability test questions in limited trials are presented in Table 7.

Table 7. The Validity of Creative Thinking Ability Test Questions in a Limited Trials

Item test	R count value	Sig value
1	0.71	0.00
2	0.42	0.00
3	0.35	0.01
4	0.39	0.02
5	0.44	0.01

Based on Table 7, it is found that the test questions developed are declared valid because the rcount value is more than rtable (0.325) at a significance level of 0.05.

Validation in a Wide-Scale Trial

The validation results of wide-scale trials conducted at three high schools, namely SMAN 2 Poso, SMAN 1 Poso Pesisir Utara and SMAN 1 Pamona Selatan are presented in Table 8.

Table 8. Validity of the Observation Sheet and Assessment Rubric for the Digital Literacy-based PJBL Model in Wide-Scale Trials

Indicator	Sig value
Creativity and originality	0.00
Understanding of material	0.00
Quality of content	0.00
Presentation skills	0.00
Team collaboration	0.00
Innovation and technolgy	0.00
Impact and relevance	0.00

Based on Table 8, it is found that the observation sheet and assessment rubric for the digital literacy-based PJBL model developed have been declared valid because the significant value is <0.05. Furthermore, the results of the validation of creative thinking ability test questions in wide-scale trials can be seen in Table 9.

Table 9. Validity of Creative Thinking Ability Test Questions in Wide-Scale Trials

Item test	Range of R count value	Sig value
1	0.71	0.00
2	0.86	0.00
3	0.73	0.00
4	0.67	0.00
5	0.76	0.00

Based on Table 9, it shows that the r count value is > 0.325 (t table) and the significant value is <0.05, so it is stated that the questions developed are valid. The high validation results are because the assessment received an excellent rating in all its aspects, indicating that it is suitable for use. The results of expert trials on the digital literacy-based PjBL learning model assessment sheet rubric only contained typing errors, thus the validity of the assessment developed was very good. In addition, both broad and limited scale trials showed very valid values with sig values <0.05. According to Hafina et al. (2022) if the expert evaluation results with an average score are classified as very good, then the model developed is suitable for application.

Reliability of Assessment Products

The results of calculating the reliability of the observation sheet and assessment rubric for the digital literacy-based PJBL model based on the results of expert trials and field trials are presented in Figure 3. Based on Figure 3, it was found that the observation sheet and assessment rubric for the digital literacy-based PJBL model that was developed had a high level of agreement between raters because the reliability value (R) was > 0.80. The results of the reliability value calculation show that expert trials obtained an R-value of 0.877, while field trials obtained an R-value of 0.885, and wide-scale trials obtained an R-value of 0.818. Thus, it can be said that the assessments made can be trusted to measure students' abilities in digital literacy and creative thinking abilities.

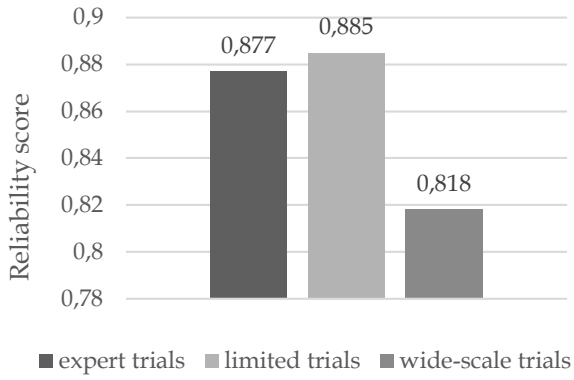


Figure 3. Reliability of the observation sheet and PJBL model assessment rubric based on digital literacy

Furthermore, the reliability of the creative thinking ability test questions in the wide-scale trial is presented in Figure 4.

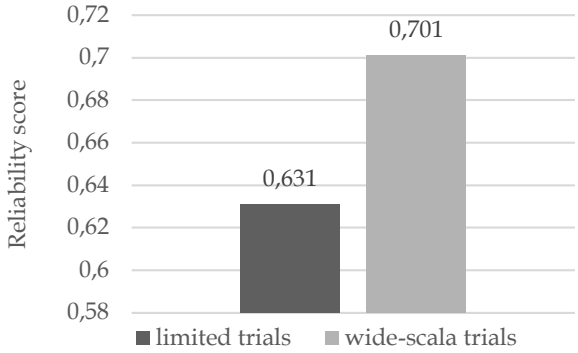


Figure 4. Reliability of creative thinking ability test questions in limited trials and large-scale trials

Based on Figure 4, it shows that the creative thinking ability test questions in the wide-scale trial have been declared reliable because the R value is > 0.60. The results of this development show that the observation sheet products and digital-based PJBL model assessment rubrics, as well as creative thinking ability test questions, are valid and reliable. This assessment product has a very valid structure and content, which is the result of a testing process carried out to test its validity. Testing of this assessment product was carried out by the procedures listed in the ADDIE model development stages. Validation carried out by experts and the field meets the predetermined validation values. Test results found that this product has consistently achieved the desired results.

The Level of Difficulty and Discrimination Power Question

The findings of the study of the questions' difficulty level in the movement system material can be presented in Table 10.

Table 10. The Questions difficulty level

Difficulty index	Category
0.633	Middle
0.765	Easy
0.695	Middle
0.861	Easy
0.534	Middle

Table 10 indicates that the questions fall into the easy and moderate difficulty categories, indicating that the generated questions are deemed to be of good quality. The findings of the examination of questions' discriminating power in the movement system material can be presented in Table 11.

Table 11. The Discrimination Power of Questions

Discrimination power index	Category
0.46	Good
0.51	Good
0.54	Good
0.51	Good
0.36	Satisfactory

Table 11 shows that the discrimination power index ranges from 0.36 to 0.54, indicating that the questions' discrimination power is categorized as good and satisfactory. As a result, the questions can be deemed good because they have the ability to distinguish between students who are capable of learning at a high level and those who are not.

Students' Digital Literacy Skill

Students' digital literacy skill through the project based learning model in high school biology learning in Poso Regency on movement systems material can be seen in Table 12.

Table 12. Students' Digital Literacy Abilities Based on Indicators Through a Project-Based Model in High School Biology Learning in Poso Regency

Digital literacy abilities	Percentage (%)
Creativity and originality	90
Understanding of material	84
Quality of content	84
Presentation skills	84
Team collaboration	88
Innovation and Technolgy	84
Impact and relevance	86

Based on Table 12 show that creativity and originality in producing work received a high score of 90%, this shows that students have realized the importance of respecting other people's work. It proves that students have good abilities by creating original work in digital literacy. This shows that students have realized the importance of respecting other people's work. It proves that students have good abilities by creating original work in digital literacy.

The impact and relevance score of 86% was in the very good category. This shows that the learning projects produced by students have a positive impact in improving digital literacy skills and there is good relevance to the biology subject matter presented. Digital literacy projects produced by students can be used as learning resources. According to Sogen et al. (2023), digital literacy-based learning is learning activities or activities that use the internet or digital technology to plan, implement and assess. Exploring the use of digital technology allows educators to create more interesting learning opportunities in presenting the learning material. Suwarto et al. (2022) further state that digital literacy attempts to enhance the skills required to access, analyze, and evaluate diverse types of information and communication, it is frequently compared to media literacy.

Improving Students' Creative Thinking Abilities

Improving students' creative thinking abilities through the digital literacy-based PJBL model in high school biology learning in Poso Regency are presented in Figure 6, it is found that the highest creative thinking ability in the detailed thinking ability indicator (elaboration) is 91% in the very good category and the lowest is in the evaluation skills indicator with a value of 65% in the good enough category. This shows that using a digital literacy-based PJBL learning model can stimulate students' creative thinking abilities. This is in line with the results of research conducted by Khauzanah et al. (2023) that through the use of digital literacy-based PJBL learning models, students are trained to find ways to solve problems encountered both individually and in groups so that students' creative thinking abilities increase.

Masaguni et al. (2023) further explained that Project-based learning involves students actively participating in the learning process, fostering improved understanding by encouraging them to create tangible projects and ideas rather than solely listening passively

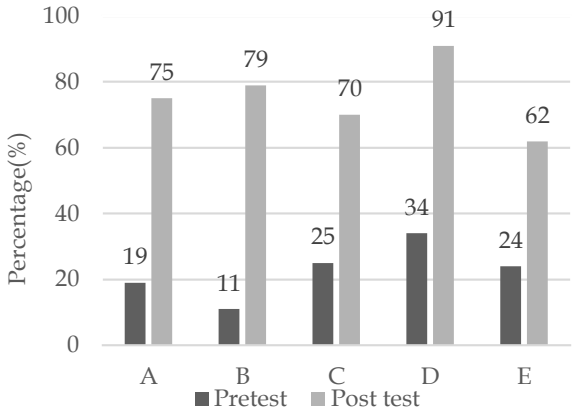


Figure 5. Improving students' creative thinking abilities: A(fluency), B(flexibility), C(originality), D(Elaboration, E(Evaluation) through the digital literacy-based PJBL model in biology learning

Furthermore the category of improving creative thinking skills can be seen in the Table 13. Based on table 13, it is shown that the highest improvement in creative thinking skills is in the abilities of elaboration (0.86). This means that students can detail an object or special situation and develop ideas specifically on movement systems material where students can analyze technology for handling disturbances in human movement systems very well. The high score obtained is also due to the

digital literacy-based PJBL learning model used that requires students to look for learning resources from various references to increase understanding of the subject matter. In line with what was stated by Eliaumra et al. (2022) one of the factors that increases the ability to think elaboratively is a good understanding of concepts, this allows students to describe simple concepts into broader concepts by providing illustrations and real examples of events that occur in society.

Table 13. The Category of Improving Creative Thinking Abilities

Creative Thinking Abilities	N-gain score	Category
Fluency	0.69	Middle
Flexibility	0.76	High
Originality	0.60	Middle
Elaboration	0.86	High
Evaluation	0.50	Middle

Flexibility thinking ability scored 79% and fluency thinking ability 75% with categories of high and middle improvement (0.76 and 0.69), which means that students have been able to apply a concept or principle in different ways and have many ideas about a problem well. This can be seen from the student's ability to solve the problems given, students can explain a concept regarding working mechanisms, especially in the material of human movement systems in the real world. This digital literacy-based PBJL learning model is believed to have been able to improve students' flexibility and fluency thinking abilities as explained by (Ringotama et al., 2022) that the Project-Based Learning model is a learning process to increase students' awareness of real-world problems, discussing problems that arise individually and collectively. In line with what (Syafrial et al., 2022) stated, the ability to think creatively has an important role in forming and enhancing a person's creativity.

Nurdian et al. (2023) also stated that the learning model that the teacher uses, the way that technology and learning strategies are combined, the students' comprehension of the problems, the teacher's learning approach, and the students' capacity for collaboration all have an impact on the students' capacity for thinking. the same within the collective. An effective teacher can help each student reach their full potential, which includes inspiring them to use their imaginations when they are studying.

Original thinking ability received a score of 70% and evaluation ability obtained a score of 62% in the good enough category. The category of creative thinking obtained an N-gain score of 0.05-0.60 (middle). The ability to think original and the ability to evaluate is an ability that involves oneself in the same situation but has other thoughts. This has not been fully demonstrated by students in solving the problems given. Some students have been able to think original and evaluate, but others have not shown this. Some of the factors causing this are the lack of students' ability to find solutions by utilizing learning resources widely and there are still students who rely on one learning resource such as textbooks available at school, so that their original thinking and evaluation skills have not been utilized optimally. According to Awaliyah et al. (2023) stated that originality is a crucial measure of creativity, which emphasizes the difficulty many students have coming up with original ideas.

The result of the research Sevani et al. (2023) explains that by implementing the Project Based Learning learning model, teachers are not only guided by students' books, but teachers can also learn from everyday problems experienced by students. This model provides the freedom to explore various learning contents from various media to be able to answer guiding questions and actively encourage independent learning by assigning projects to students.

A recapitulation of the improving creative thinking abilities before and after implementing the PJBL model assessment based on digital literacy can be seen in the figure 6.

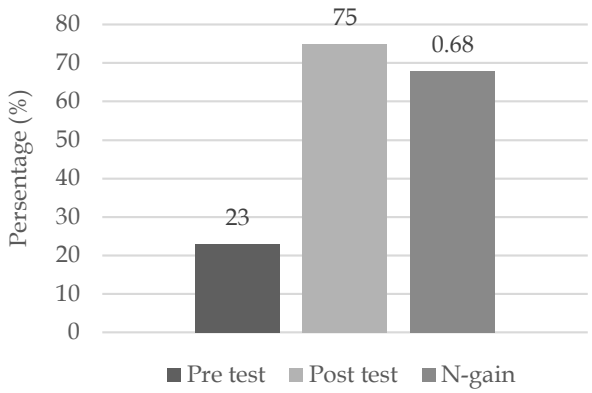


Figure 6. Improving creative thinking abilities before and after implementing the PJBL model assessment based on digital literacy

Based on Figure 6, it can be seen that improving students' creative thinking abilities is in the medium category with an N-gain score of 0.68. Overall digital literacy skills and creative thinking skills in biology learning for high school students in Poso Regency can be seen in Figure 7.

Based on Figure 7, it shows that students' digital literacy abilities in biology learning through the project based learning model are very good with a score of 86% and creative thinking abilities are categorized as good with a score of 75%. Students understand and are skilled at using digital literacy in learning. This is as stated by

Ussarn et al. (2022) and Lestari et al. (2023) that digital literacy is a survival skill in the digital era and will enable students to apply their skills in assigned work. Digital literacy is very important for internet users in a broader sense as a survival skills in the digital era where everything has been digitalized. This will also be useful for students who can become future leaders in certain fields.

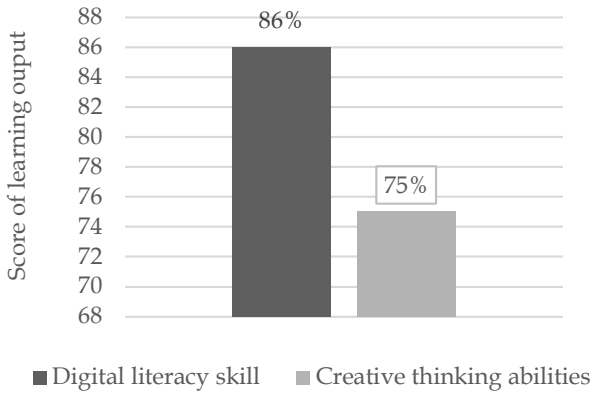


Figure 7. Digital literacy abilities and creative thinking abilities in biology learning for high school students in Poso Regency

The results of interviews with students show that students really expect digital-based teaching materials or learning resources that can help them read and understand them. They also believe that because digital-based literacy media is a new literacy medium for them, they hope it can be used as a reliable reference so that students can understand it well.

These high results are due to the high motivation shown by students during the learning process. This motivation encourages them to actively seek information about subject matter flexibly, not limited to printed books at school or the library. In addition, students' tendency to seek information through digital tools and interact in cyberspace also provides a special attraction, which has a positive impact on their understanding of the material being studied. Suwarto et al. (2022) explained that digital literacy has three important goals, namely encouraging students to carry out personal reflection in their social context. Second, encourage emotional cognitive learning using digital tools. Third, create a learning environment, including risk-taking, experimentation, creativity and innovative process design.

By using this Pjbl model, difficult problems and complex activities are prioritized to encourage students to be creative, manage work, and produce original products. Students learn by connecting their existing knowledge with new knowledge so that they can gain a solid understanding. Students are also allowed to develop their own knowledge through the process of research and exploration and encourages more meaningful learning and more active student involvement in learning so as to get good results in learning (Hikmah et al., 2023; Aprida & Mayarni, 2023).

Conclusion

The research findings confirm the validity and reliability of observation sheets and assessment rubrics developed for project-based learning models centered on digital literacy and creative thinking. Digital literacy scored an average of 86%, indicating a "very good" level, while creative thinking scored 75%, categorizing as "good." The assessment effectively improved students' creative thinking, reflected in an N-gain score of 0.68 in the "middle" category. Consequently, this assessment is deemed suitable for high school biology education, showcasing its potential to enhance students' creative thinking abilities.

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Conflicts of Interest
The authors declare no conflict of interest.

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