

Development of an Alternative Assessment of Scientific Literature Skills for Students of Prospective Biology Teacher

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Abstract. The results of the observation showed lack of interest in reading and empowering the skills of critical thinking among students of prospective biology teacher education. The first phase of the present study aims to develop an alternative assessment of scientific literature skills for students of prospective biology teacher education, which include informational literacy, skills in writing learning journal, reports of practical training and presentation. The method utilized in the present study was ADDIE model. The development model covers five steps, i.e. *Analysis, Design, Development, Implementation* and *Evaluation*. The present study resulted in a proper and ready-to-use alternative assessment of scientific literature skills, communication, reading and writing. The conclusion of the study presents the percentage of informational literacy with logical validity of 88.51%, skills in writing learning journal 90.26%, reports of practical training 89.27% and presentation 88.16%. The implementation of the alternative assessment has received positive responses from practitioners as well as students. The results of the implementation also showed that the assessment instruments are proved to be reliable, gaining 0.88.

Keywords: alternative assessment, scientific literature skills, prospective biology teachers

INTRODUCTION

Students often see assessment in traditional paradigm as a negative impact on learning, especially when there is a high expectation attached to the test scores. The new paradigm in the 21st century, on the other hand, shows that when the assessment is well-planned and well-implemented, it could provide positive impact on the efforts to achieve the learning target. The appropriate assessment to use is the authentic assessment, also known as an alternative assessment [1]. Wulan [2] presented that alternative assessment is an assessment of process and product of learning which can be applied to assess the competence of knowledge, skills and behavior. According to Ibrahim [3], in addition to measure the concept of subject matter, an alternative assessment can also be utilized to empower scientific literature skills, including communication (speaking, reading, writing and listening). Imam, *et al.* [4] stated that reading skill has always been seen as important for academic excellence, and studies have shown the importance of reading in academic fields, especially in higher education.

The results of preliminary study showed that students of prospective biology teacher education in the class of Plant Growth Structure (SPT) exhibit low interest in reading scientific literature. The students tend to

behave passively in receiving information provided during interactive activities, rarely offer criticism, arguments and ideas, making them unable to develop skills in critical thinking. From the interviews with the student, it was concluded that the inability in comprehensively reading scientific literature becomes the main obstacle that causes frustration in learning. In light of this fact, studies in the development of alternative assessment is needed, especially in regards of scientific literature skills. During the learning activities in SPT subject, students have been assigned tasks to write reports of practical training and presentation of the activities, but there has not been an appropriate assessment for it. SPT is one of the mandatory subjects for students taking Biology or Biology Education Study Program at the Faculty of Mathematics and Science in Universitas Negeri Malang [5].

Akin, *et al.* [6] stated that reading is one of the most important basic linguistic skills required in developing students' intellectual lives, due to its significant role as a tool to help students in analyzing, interpreting and communicating scientific ideas. Reading habits are more than just a means to gather knowledge and inspirations, but also to improve students' critical and logical thinking. This corresponds well with the opinion from Tung & Chang [7] that reading is an effective learning activity for students to improve their critical thinking skills.

Porter [8] pointed out that students often are not aware of the important roles of reading materials in the process of scientific studies, and lecturers do not always emphasize the importance of adequate references. When students find reading materials, they often have difficulties in understanding and digesting the information. This is due to the style of the scientific journals that is different from most of other journals, including their text books. Scientific journals or articles could also be difficult because such materials are aimed at readers with experiences in the specific topics, not just those who understand the methods, results and implications of unknown studies. It is important to introduce scientific reading materials to the students as early as possible. In addition, Imam, *et al.* [4] also stated that students typically agree that reading skills are among the key factors that determine academic success, despite the more complicated nature of the scientific concepts as compared to other materials.

This present study was conducted in two stages. The first stage aims to develop an alternative assessment instrument for scientific literature communication skills, which include information literacy, writing learning journals, practical training reports and presentation among students of prospective biology teacher education. The second stage aims at the implementation of the alternative assessment to improve critical thinking skills. As stated by Pellegrino [1], an assessment is not just a tool to collect data, as presented in the traditional paradigm, but also to present influence in learning process. Ibrahim [3] suggested that an alternative assessment to assess the results of scientific education in the 21st century can be implemented by integrating the learning process with assessment process.

RESEARCH METHODS

The present study was conducted at the Department of Biology of FMIPA UM towards the students of Plant Structure and Growth 2 subject in the even semester of 2016/2017. The study was conducted from the beginning of course period until the final exam for the semester (UAS). The subjects of the study were 90 students from 3 classes of Biology Education Study Program. This is a study of the development of an alternative assessment of scientific literature skills using *ADDIE* model which covers the stages of *Analysis, Design, Development, Implementation, and Evaluation* [9], as shown in Figure 1.

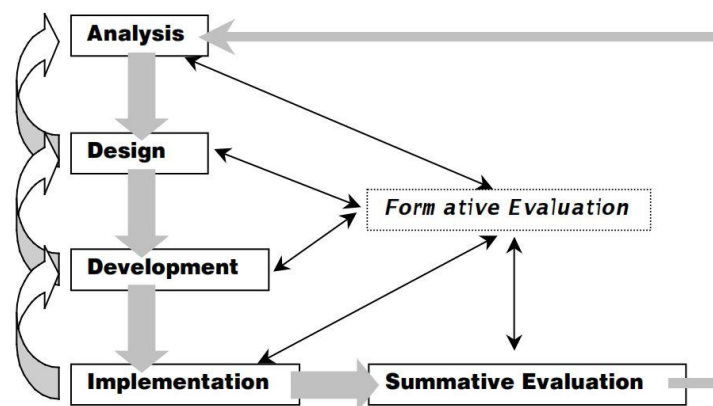


Figure 1 ADDIE Development Model [10]

Instrument logic validation test was conducted by *expert judgment*, which covered assessment experts as well as material experts. The data for this study and development was collected from quantitative and qualitative data. The quantitative data was collected from the results of expert judgment, practitioners, and students via questionnaire. The qualitative data were collected by means of preliminary studies, documentaries, suggestions, feedback from experts, practitioners and student responses. The data analysis method used was descriptive statistics and qualitative descriptive analysis. Descriptive statistics was used to process data in forms of expert judgment scores, responses from practitioners and students by using percentage formula. The reliability measurement was using inter-rater agreement formula.

RESULTS

The results of this development study are alternative assessment of scientific literature skills, i.e. reading and writing with scientific approaches among the students of prospective biology teacher education. This development study utilized ADDIE model consisting of analysis, design, development, implementation and evaluation. The analysis stage was an issue identification process, including requirement analysis by means of preliminary studies which cover curriculum analysis, students' profiles, material analysis and assignment analysis.

The design stage was the process of specifying the product prototype of the scientific literature alternative assessment. The results show that the prototype to be developed by the alternative assessment includes scientific literature information, writing learning journals, practical training and presentation. The development stage involved the production process of an alternative assessment, which was then validated by assessment experts, subject matter experts and practitioners. After validation, the assessment instrument went through several courses of revision aiming at improving the assessment instrument being developed to ensure proper implementation. The correction and improvement processes of the assessment instrument were performed under the guidance from validators. The validation results present the percentage of informational literacy with logical validity of 88.51%, skills in writing learning journal 90.26%, reports of practical training 89.27% and presentation 88.16%. The implementation of the alternative assessment has received positive responses from practitioners as well as students. The results of the implementation also showed that the assessment instruments are proved to be reliable, gaining 0.88. The Criteria of Product Validity Level based on the criteria of validity level by Akbar [11] in short can be shown in Table 1. Besides quantitative data, qualitative data collected from the validators' suggestions and feedback were also analyzed.

Table 1. Criteria of Product Validity Level

Level of Achievement	Validity criteria	Follow-Up
86-100%	Highly Valid	Implementation
71-85%	Valid	Implementation
56-70%	Fairly Valid	Need revision

$\leq 55\%$	Invalid	Need revision
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The implementation stage of alternative assessment process in the real context was directed at the students of SPT subject. The responses from practitioners and students showed positive results, which included excitement, curiosity, engagement, empowerment, convenience, efficiency and interest in working on the tasks of the alternative assessment, i.e. information literacy, writing learning journals, practical training reports and presentation delivered during SPT classes. Student Responses are shown in histogram Figure 2. The formative evaluation process was conducted to determine the adequacy of instructions for analysis, design and development stages, while summative evaluation was performed during implementation stage.

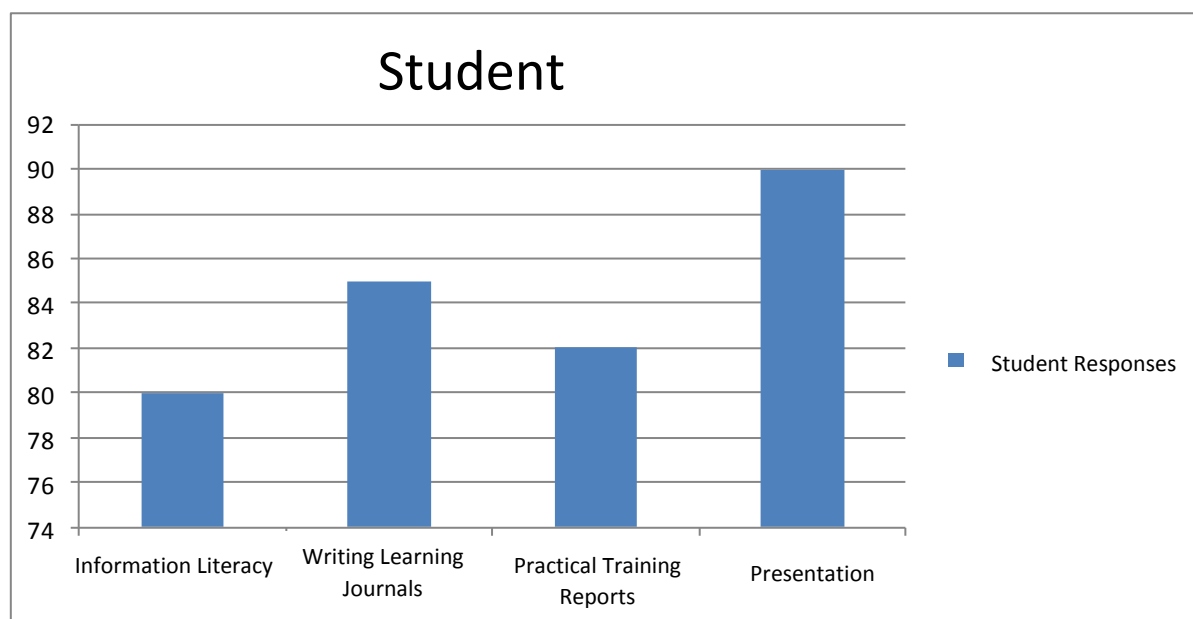


Figure 2 Student Responses

DISCUSSION

The results of this development study with ADDIE model are alternative assessment of scientific literature skills, i.e. reading and writing with scientific approaches among students of prospective biology teacher education. Shwartz [12] stated that the aspects of scientific literacy from different philosophical viewpoint and theoretical framework result in different research developments as the following: 1) measuring the recall of scientific knowledge in school. Material knowledge is normally considered as important for scientific literacy because it is the most prominent aspect assessed by science teachers and educators; 2) measuring the skills to implement scientific principles in non-academical contexts. The key characteristics of the tools are designing original tasks (such as reading information on the subject matter being taught), and evaluating performance of skills; 3) measuring reading and writing skills in scientific contexts, which is meant to evaluating individual skills in reading, writing, providing reasons and asking for further information; 4) measuring students' understanding of nature of science (NOS) and their understanding of science and behaviors towards Science-Technology-Society (STS) topics.

The focus of this development study on alternative assessment of scientific literature skills was on the students of prospective biology teacher education. Findings from the study conducted by Sari [13] showed that biology teachers in Malang County high schools have not empowered scientific literature skills in making assessment of low cognitive level. This is in line with the statement from Drago [14] that many teachers

(68.5%) have agreed that all of the power needed by the curriculum for science is highly important for scientific literacy. Teachers claimed that they are qualified in teaching this set of skills and being understood by the students. However, when they were asked to write down three most important skills that should be developed for scientific literacy, most of the answers were related to biology knowledge instead of the skills themselves. It can be seen that there is insufficiency in skills as well as time to develop and integrate the development scientific literature skills.

The development study of scientific literature skill alternative assessment, i.e. reading and writing with scientific approaches on the first stage was aimed at improving skills of critical thinking. This is in line with the findings from a study conducted by Tung & Chang [7] that information literacy requires critical thinking abilities. Information literacy by reading literatures is a complex process that requires readers to memorize, grasp and ponder on previous experiences to build on the meaning of the text. While doing this, students need to show their capacity 1) to differentiate facts from opinions; 2) to understand the explicit and implicit meaning in the narrator's tone; 3) to find the details related to the issues being discussed; 4) to understand the causative relations and the relationship between events and reactions; 5) to recognize the inferential relationship from the details being observed; 6) to be perceptive of multiple viewpoints; 7) to render moral reasoning and fair judgment; and most importantly, to implement the lessons from the process to other domains or in the real life. For this reason, students in pursuit of information literacy are encouraged to develop indicators of critical thinking, such as analysis, synthesis, argument and problem solving. Developing critical thinking skills in students has been set as the goal of 21st century higher education.

From the questionnaire results of analysis of scientific literature skills among students of SPT in the Department of Biology in Universitas Negeri Malang, Sari [5] in her preliminary study showed that the component of inhibitors towards information literacy was as big as 83.3%. Students were having difficulties with information literacy. Cooper [15] stated that the lack of understanding in reading scientific texts causes frustration among students when learning about science. It was said that when the reading skills are inadequate, problems will occur, which create frustration in learning process. Studies have shown the importance of reading skills in understanding as well as academic achievements.

Karadeniz [16] added that reading is a complex activity that requires complex skills. To be able to read well, it needs focus, memory, ability and process of understanding the reading materials, which is why multi-level cognitive processes are required. This is in line with Imam [4] who emphasized that many reading materials are difficult to understand because readers tend to omit essential background information and fail to connect the concepts in the text explicitly. While students might have the skills to read and know the words, identify and find information and memorize content, they might not be able to analyze, summarize nor criticize the texts when requested.

The development products include information literacy, writing learning journals and reports of practical training, and project-based presentation. Turiman [17] stated that information literacy is a set of skills to evaluate information in various media; to recognize when the information is needed; to find, synthesize and use the information effectively; and to accomplish this function by using technology, communication networks and electronic resources. The results of information literacy assessment with logical validation among students of prospective biology teacher education showed high validity, and the results of implementation showed positive responses from practitioners and students. Porter [8] stated that the information literacy skills are critical for undergraduate students of biology, which is why it has to be empowered. The ability to find, understand, evaluate and use information from any scientific reading materials or web sources are essential in order to achieve proper understanding of the topics and to conduct studies.

For this study development of scientific literacy skills, in addition to information literacy, students were also assigned supporting tasks of writing learning journals, reports of practical training and presentation. A better performance in writing assignments reflected the fact that students generally have more practices from writing tasks. The implementation of writing learning journals gathered positive responses from students. Learning journals are one of the means that is ideal to strengthen the communication system between lecturers and students in learning process. Surapranata [18] stated that learning journals reflect the active learning method containing learning reflections written by students after the learning activities. Additionally, students can also write materials or concepts that they have not fully understood and their

experience during the learning activities. This can build the communication or share the learning process between lecturers and students.

The scientific literacy assessment with logical validation that has been developed, whether it is writing learning journals or reports and presentation is deemed to be valid and reliable enough to be implemented in future studies. The scientific literacy skill assessment that has been developed is an interrelated assignment that demonstrates the students' actual abilities in reading and writing to process complex information. Students often do not realize that they have to go through all of the activities in the development to compose practical training reports and presentation, because the assignments are divided into focus and time that demand the students to accumulate based on the information literacy and the understanding of course materials in one semester. Additionally, the study of alternative assessment achieved a reliability score of 0.88. Mardapi [19] stated that reliability calculation results are used to measure the consistency of instrument so that it can be compared through times to learn the development of learning results.

The results from the overall information literacy alternative assessment have been written as papers of practical training and been presented. A scientific literacy skill assessment by means of task presentation requires students to demonstrate their actual skills in processing complex information. Students stated that they feel more effective in developing critical thinking by working on presentation in class. Ibrahim [3] on the development of alternative assessment stated that all skills to be accessed have to be identified clearly, determined as indicators and best performances that are required for each indicator. The indicators and performance quality become the guide to demonstrate skills, used by the students to practice, and then used as the assessment guide.

CONCLUSION

The conclusion derived from the results of this study on the instrument development of alternative assessment for communication scientific literacy skills, which cover information literacy, writing learning journals, practical training reports and presentation among students of prospective biology teacher education, are deemed valid and reliable to be implemented in future studies. The informational literacy with logical validity of 88.51%, skills in writing learning journal 90.26%, reports of practical training 89.27% and presentation 88.16%. The implementation of the alternative assessment has received positive responses from practitioners as well as students. The results of the implementation also showed that the assessment instruments are proved to be reliable, gaining 0.88.

ACKNOWLEDGMENTS

This study was supported by DP2M Ditjen Dikti who funded the Basic Research of Excellence Program for Higher Education (PDUPT) Fiscal Year 2018 through LP2M UM Malang. We also thank our colleagues in LP2M Universitas Negeri Malang.

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