

# Life Skill Integrated Science-PBL Module to Improve Critical Thinking Skills of Secondary School Students

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**Abstract** This study was intended to: (1) describe the results of the development of the Life Skill integrated Science-PBL module, (2) analyze the feasibility of the Life Skill integrated Science-PBL module, and (3) oversee the effectiveness of the module to improve critical thinking skills of students at the secondary school level. The development model used was the 4D Thiagarajan model which consisted of four stages of development, namely define, design, develop, and disseminate. The study sample was taken as many as 97 students from three different schools. The data collection instruments were questionnaires, observation sheets, and tests of critical thinking skills. The feasibility test involved material and media expert lecturers, as well as practitioners. The effectiveness of the module was measured by finding a normalized gain score for the pretest-posttest conducted during a field trial or implementation trial. The results suggested that the Life Skill integrated Science-PBL module was suitable for use in the learning process based on the results of the validation of experts and practitioners. The calculation of the N-gain obtained the value of 0.72, which meant that the Life Skill integrated Science-PBL module was effective in improving students' critical thinking skills. The results of the questionnaire analysis of student and teacher responses showed that overall, the module received good responses.

**Keywords** Critical Thinking, Life Skill, Module, PBL, Science

## 1. Introduction

The education process in the 21st-Century should prioritize learning to develop Higher-Order Thinking Skills/HOTS capabilities, provide rich and authentic

experiences to inquire, question, discover, build deep knowledge and understanding, as well as create creative and innovative individuals [1,2]. One component of HOTS is critical thinking [3-5]. Critical thinking is the activity of thinking that has the purpose of proving, interpreting what happened, and solving problems. Indicators of critical thinking are interpreting, inferring, organizing, analyzing, evaluating, and explaining situations [6].

Learning should be able to encourage students to have main competencies, namely the ability to communicate, work together, be confident, problem-solving [7], and life skills in a variety of forms [8,9]. Life skills can be interpreted as the ability to adapt and behave positively so that individuals can live independently [10-12]. Someone who has life skills means having personal, social, intellectual, work skills and can strive to live independently [13]. Life skills are important for students because the skills will provide them with a good quality of life in the community in the future [14,15].

The Science learning process - including Biology material - is also expected to provide HOTS practices [16-19], and life skills learning for students [20-22]. Therefore, the Science learning step must be following its essence, which includes processes and products [21,23], [24]. Based on the depth of learning, Science has to be viewed from four dimensions, such as its ways of thinking, ways to investigate, the body of knowledge, and science and its interactions with technology and society [25]. For the Science learning process to be achieved that is relevant to the competencies set out in learning, a learning component is needed, including teaching materials [26-29]. Teaching materials are required in the learning process with the aim that students are more motivated in learning and trained in their independence to achieve competence [30-32]. Teachers are expected to develop teaching materials that are not only focused on one source so that they can provide meaningful experiences for

students.

The research team has made observations at three junior high schools in Kupang city, East Nusa Tenggara Province-Indonesia, namely SMP Negeri 4, SMP Negeri 16, and SMP Muhammadiyah Kupang. The reality in the field revealed that most teachers used teaching materials that had been provided by the government or from a publisher. The teaching materials were less suitable for the competencies to be achieved in learning. This caused students to be less motivated in learning, and less able to solve the problems given by the teacher or could not think critically. As a result of the unfamiliar learning with problem-solving models and not using teaching materials that attract students' learning interest, learning seemed to be less meaningful and could not meet the demands of learning in the 21st century.

Observation results also suggested that most students had not been able to solve all the problems given by the teacher. Students had difficulties to analyze arguments and draw conclusions from an investigation. Most students were not fluent in answering questions given by the teacher. The learning process carried out by Science teachers was more likely to be verbal, and learning was still oriented towards cognitive learning outcomes. The aspects of life skills had not been touched or under-developed. Based on the results of observations on teaching materials used by teachers, the content of life skills had not been listed in it and had not trained students' critical thinking skills.

Based on the preliminary findings, as well as in the context of improving the quality of learning according to the competencies to be achieved by the teacher, currently, it is necessary to develop a Life Skill integrated Science-PBL module to improve the critical thinking skills of students at the secondary school level. This development is based on the view that modules can be used for independent learning because they are self-contained and self-instructed [33]. The module is an independent learning package that includes a series of learning experiences that are planned and systematically designed to help students achieve learning goals [34,35]. Meanwhile, PBL is a learning (and a curricular) approach that is centered on students who empower themselves to conduct studies, integrate theory and practice, and apply knowledge and skills to develop solutions that are feasible for specified problems [36-39]. Students use "triggers" from problem cases or scenarios to determine their own learning goals [40-42]. Yew and Goh concluded based on the results of their review of research that PBL is generally consistent in showing its superior efficacy for long-term knowledge retention and in the application of knowledge [43].

Some research has focused on PBL modules, for example for the theme of physics [44-49], mathematics [50,51], and biology [52-54]. In a limited number of studies, some focus on the relations of PBL modules in mathematics learning with aspects of critical thinking in

high school level [55], PBL modules in physics and chemistry learning with aspects of critical thinking in high school level [46,56,57], and two studies that links PBL modules in learning biology with aspects of critical thinking [58,59]. There are only two studies that try to link PBL with life skills, namely the provision of life and career skills using the PBL method in the gasoline engine curriculum [60] and assessing the motivation and life skills of second-year nursing students before and after taking courses that involve PBL [61]. Moreover, in the last 30 years, the SCOPUS database noted that there were only two studies of junior high school themes and life skills [62,63]. However, there has not been any study related to the development of PBL-Life Skills integrated Science modules, especially in Indonesia.

Therefore, we have developed a Life Skill integrated Science-PBL module to improve students' critical thinking skills at the secondary school level. This article aims to: (1) describe the results of developing the Life Skill integrated Science-PBL module, (2) analyze the feasibility of the Life Skill integrated Science-PBL module, and (3) analyze the effectiveness of the Life Skill integrated Science-PBL module to improve students' critical thinking skills at the secondary school level.

The article is expected to contribute practically in encouraging teachers to apply the latest learning strategies and teaching materials that are in line with efforts to strengthen various 21st-century skills, in this case by applying the Life Skill integrated Science-PBL module. This article also theoretically encourages researchers in education and learning fields to study PBL and the development of teaching materials through various perspectives and interventions so that it will further enrich options for implementation in various educational institutions.

## 2. Materials and Methods

### 2.1. Development Model

The development of the Life Skill integrated Problem Based Learning (PBL) module in this study adopted the 4D Thiagarajan model [64]. The 4D model consists of four stages, namely define, design, develop, and disseminate.

### 2.2. Population and Samples

The population in this study were all VII grade students of junior high schools in Kupang city, East Nusa Tenggara-Indonesia. Samples for the study were taken from as many as 97 students from three schools relevant to the research objectives.

### 2.3. Data Collection Instruments

The instruments used to collect data were: 1) validation

sheets; 2) observation sheet of syntax learning implementation; 3) student responses to the Life Skills integrated Science-PBL module developed, and 4) critical thinking skills tests compiled by referring to Bloom's taxonomy.

**2.4. Data Analysis Technique**

The data obtained in this study were descriptive qualitative and quantitative analytical data. Descriptive qualitative analysis techniques were carried out by the needs analysis, while descriptive quantitative-qualitative was carried out based on data scores from validation of experts and practitioners, or limited trial results, and data from field trial results (in the form of inputs, responses, suggestions, and criticisms for improvement) displayed in the questionnaire. The results of this analysis were then used to revise product development. Descriptive quantitative was required to process data in percentage form. The module effectiveness analysis was derived by finding a normalized gain score (<g>) for the pretest-posttest in the field test class. As an initial step, an effectiveness test was first performed at three schools, then the average was calculated to look for the N-gain of the students' critical thinking skills.

**3. Results and Discussion**

**3.1. Results**

**3.1.1. Define Stage**

The initial activities that were implemented at the 'define' stage were analyzes of curriculum, students, materials, and goals formulation. The initial analyzes were carried out by conducting observations and interviews with Science teachers at the secondary school level in Kupang city. Based on the results of the questionnaire that was given to students, around 80% of students stated that so far the textbooks used were textbooks that were available or had been provided by the government or by publishers. The textbook used only contains theories and instructions that must be implemented by students with a scientific approach but has not implemented learning models that can practice critical thinking skills, and there are no problems raised at the beginning of learning. According to the teacher, the textbooks are arranged with less attention to the content of the environment around students on pollution material, and lack of practicing students' ability to solve problems in daily life or have not applied the content of life skills.

According to Hamdani [65], learning occurs when there is an interaction between individuals and the environment, and textbooks that do not support learning will make students less motivated in learning and will hinder the development of their abilities in the future. Teachers need

to develop teaching materials that are relevant to the demands of the times [40,43,66-70]. To overcome these obstacles and difficulties of the teachers, the role of lecturers in higher education is needed in the process of developing teaching materials that can answer current challenges [71-74].

**3.1.2. Design Stage**

The 'design' stage produced a teaching material product in the form of a module. The developed module was arranged by identifying the basic competencies used in learning. The preparation of the module began with initial analysis and continued with setting the title, compiling a concept map, identifying basic competencies, reviewing the material, designing the forms of activities used, and identifying indicators of competency achievement. The module that was developed in the design step consisted of the initial parts such as the title page, preface, table of contents, list of figures, student instructions, concept maps, and PBL model syntax. Also, in preparing the material contained in the module, the team considered some basic life skills that aimed to prepare students to be able to face a variety of problems that exist in their lives. The Science-PBL module consisted of 3 (three) learning activities, namely: 1) Learning activities I: Effects of environmental pollution; 2) Learning activities II: Waste Management (*Nata de Soya*); and 3) Learning activities III: Advanced Waste Management.

In the design stage, the developed module has undergone a validation stage. Validation was conducted to see the feasibility of all learning components needed before the actual field test. The validation results were used to determine the practicality of the module and learning tools in the learning process. Validation was performed by material experts and media experts, as well as practitioners. The results of the product validation by expert lecturers and practitioners are presented in Table 1 as follows:

**Table 1.** First draft validation (Lecturers and Practitioners)

Component	Evaluation Score			Average	Category
	VI	V2	V3		
Syllabus	4	3.8	4	3.93	Valid
Lesson Plan	3.9	4	4.2	4.03	Very valid
Module	4	4	4.3	4.10	Very valid
Questionnaire	4	4.2	3.8	4.00	Very valid
Observation Sheet	4	4,1	4	3.96	Valid
Test items of critical thinking	3.8	4	3.8	3.80	Valid
Average				3.97	Valid

Table 1 illustrates the validation values of the three validators for the learning tools, module, and instruments used which were the results of the validation score analysis.

Based on the validation results of the lesson plan, module, and questionnaires used in learning, an average value of 4.00 or more was obtained with a very valid category. While the syllabus, the observation sheets, and the critical thinking question items that had been validated were in the valid category with an average score of 3.80 to 3.96. The level of eligibility of the Life Skill integrated Science-PBL module could be reviewed from the results of the validation as well. This shows that all the learning tools, modules, and instruments were ready to be used with the learning model aiming at measuring the critical thinking skills of grade VII of junior high school students. Analysis of the results of the validation score indicated the average value of the module

validation that was 3.97 and it was declared valid.

A serious effort was needed in developing a module based on PBL to be used in learning at schools [50]. The module should meet the valid criteria for use as independent study material [48]. Learning with modules aims to enable students to follow teaching programs according to their speed and abilities, learn more independently, be able to know the results of their learning, and emphasize optimal mastery of the learning materials [45].

Figure 1, Figure 2, Figure 3, and Figure 4 shows an example of several pages in the module section that has been developed.



Figure 1. Cover of module (the title in Indonesian Language)

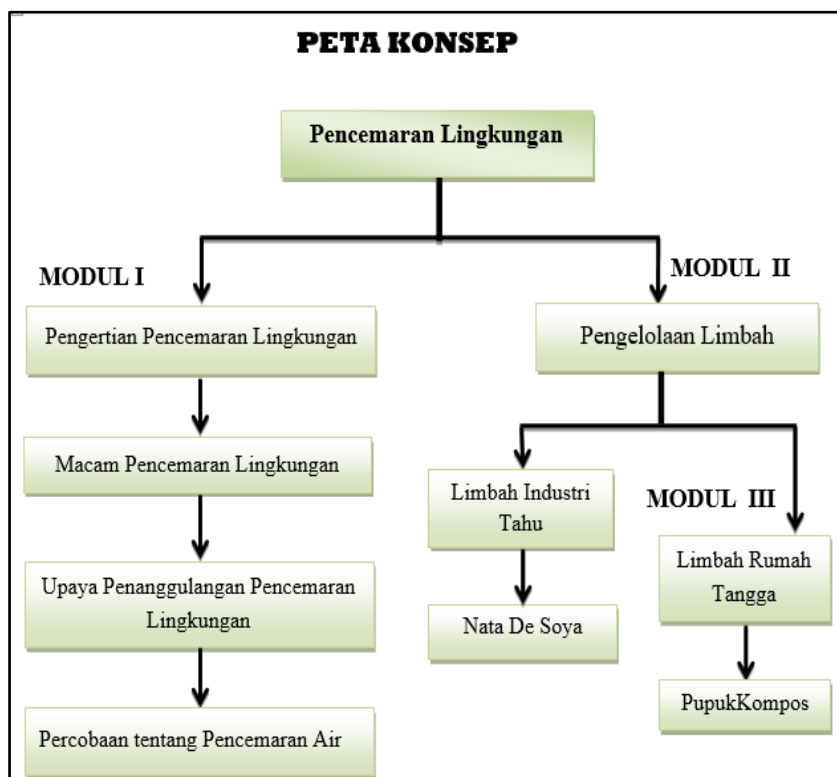


Figure 2. Concept map page (in Indonesian Language)

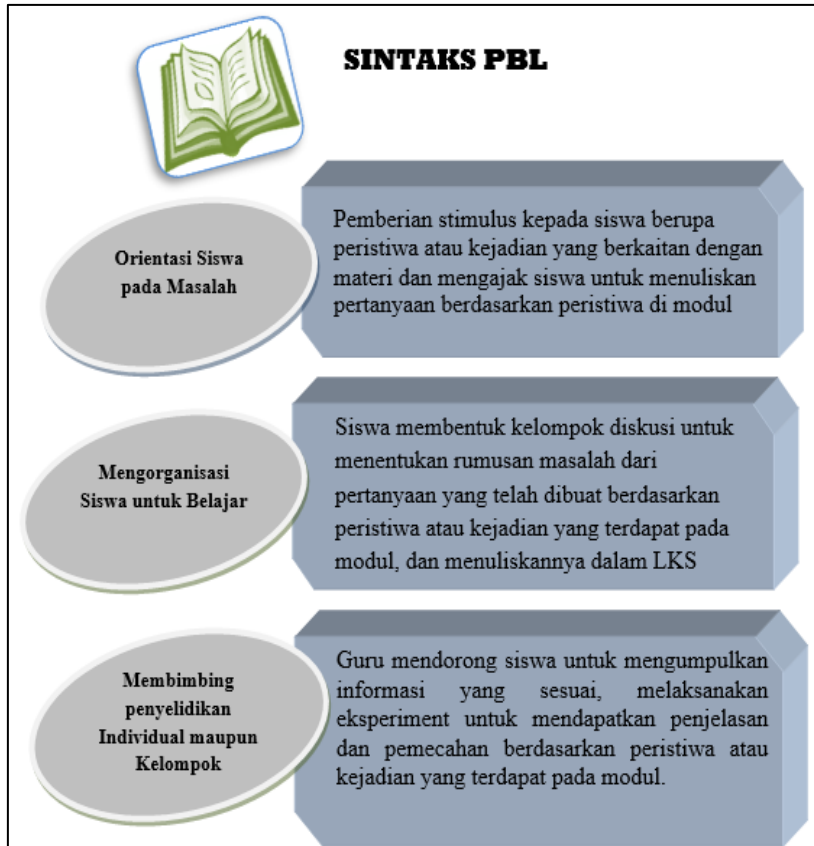


Figure 3. PBL syntax page (in Indonesian Language)

**Tahukah kamu...?**

Air merupakan salah satu kebutuhan hidup yang paling penting. Tanpa air, berbagai proses kehidupan tidak dapat berlangsung dengan baik. Walaupun kita tahu bahwa air merupakan sumber daya alam yang dapat diperbarui oleh alam sendiri, namun faktanya ketersediaan air tanah tidak bertambah. Di Indonesia, akses terhadap air bersih masih menjadi masalah. Pesatnya pembangunan dan laju pertumbuhan penduduk yang tinggi membutuhkan air dalam jumlah yang banyak seringkali tidak tersedia, sehingga dapat diketahui bahwa pembangunan yang baik adalah pembangunan yang juga menyediakan kualitas dan kuantitas air bersih. Meski demikian, kepedulian masyarakat terhadap kebutuhan akan air bersih masih sangat minim yakni ditandai dengan adanya tindakan yang merugikan alam juga organisme lain. Hal ini menunjukkan bahwa ketidaktersediaan air bersih secara umum disebabkan oleh selain faktor alam itu sendiri juga oleh tindakan manusia dengan tingkat kepedulian terhadap alam rendah.

Figure 4. Problem orientation phase page (in Indonesian Language)

### 3.1.3. Develop Stage

The 'develop' stage consisted of a limited trial and implementation trial. A limited trial was given to 15 students in the sample class before actual learning took place. Students were given a Life Skill integrated Science-PBL module, then asked to study and respond to the module that had been distributed and learned by filling out a prepared questionnaire. Students responded by selecting answer choices, 1: inadequate; 2: less adequate; 3: adequate/good; and 4: very good. The results of students' responses to the Life Skill integrated Science-PBL module are displayed in Table 2.

**Table 2.** Students' Responses Data

Aspect	Score (%)	Category
Overall module feasibility	78	Good
Presentation feasibility	77	Good
Graphics	78	Good
Contents	76	Good
Relevancy with PBL learning	80	Good
Compatibility with Critical Thinking Skills	75	Good

Table 2 shows that the questionnaire responses given to students related to the learning modules that had been given as a whole received good responses. Aspects of the module generally consisted of the feasibility of presentation, graphics, and content, relevancy with PBL learning, and compatibility with critical thinking skills.

**Table 3.** Descriptive analysis results of critical thinking skills in the experimental class

Schools	Range	Min. Score	Max. Score	Ave. Score	Standard Deviation
Pretest-SMP Muhammadiyah Kupang	25	30	65	56.87	7.65
Posttest-SMP Muhammadiyah Kupang	35	50	85	72.73	5.79
Pretest-SMP Negeri 16 Kupang	39	36	75	54.62	9.56
Posttest-SMP Negeri 16 Kupang	43	45	88	69.85	5.96
Pretest SMP Negeri 4 Kupang	30	43	73	61.76	7.74
Posttest SMP Negeri 4 Kupang	40	46	86	73.12	5.68

At develop stage, upon the completion of the validation or feasibility testing, the next step was to determine the effectiveness of the module. The developed module was

tested for its effectiveness in improving students' critical thinking skills. The results of the descriptive analysis of students' critical thinking skills on environmental pollution material for the pretest and posttest data in the three schools are presented in Table 3.

From Table 3, it is known that the highest average pretest is at SMP Negeri 4 Kupang and the lowest pretest is at SMP Negeri 16 Kupang. While the lowest average score for the posttest is SMP Negeri 4 Kupang, and the highest is at SMP Negeri 16 Kupang. The average value of pretest to posttest has a significant increase after being fostered by using the Life Skills integrated Science-PBL module. Based on the research results obtained, the highest standard deviation is at the pretest value in SMP Negeri 16 Kupang, and the lowest is at SMP Muhammadiyah Kupang. The high posttest scores in the experimental class with the existing standard deviations indicate the distribution of student grades close to the average so that the exercised scaffolding was implemented successfully.

Based on the results of critical thinking skills analysis, the level of effectiveness of learning using the Life Skill integrated Science-PBL module could be formulated. Data normality test using Kolmogorov-Smirnov obtained a significance level of pretest of 0.192 and a posttest of 0.03 and for the experimental class the significance level of the pretest was 0.168 and posttest was 0.16. The values projected that both the experimental class and the control class values were greater than  $\alpha = 0.05$  so that  $H_0$  was accepted and it can be concluded that the experimental and control classes were normally distributed. Based on the homogeneity test results for the two dependent groups that paired between pretest and posttest, the significant value was obtained, with a p-value of 0.181. Therefore it can be concluded that p-value  $> 0.05$  then  $H_0$  was accepted, it means that the data were homogeneous in distribution. Analysis of the next posttest value is shown in Table 4.

**Table 4.** ANACOVA Test

Variable	F	Significance Level	Partial eta Squared	Decision
Experiment and Control Classes	94.28	0.000 (sig<0.05)	0.664	Ho was rejected

Table 4 presents the data of the different test results between the pretest and posttest, which obtained a significance of 0.000. The analysis shows that there are significant differences between pretest and posttest. From the test results, it can be concluded that there were differences in students' critical thinking skills before and after learning using the Life Skill integrated Science-PBL module on Environmental Pollution material. Based on the results of the analysis it is necessary to do problem-based learning, which is useful for improving the critical thinking skills of junior high school students. The level of effectiveness in the selection of one component of learning, including teaching materials in the form of the Life Skill integrated Science-PBL module with Environmental

Pollution material needs to be implemented urgently by Science or Biology teachers.

According to Lestari and Winarsih [75], the level of effectiveness of this module portrays that the module contains concepts and selected materials that fit the learning needs, which pay attention to the development of science and technology, and are equipped with various features that can provide additional information to broaden learners' horizons. Ikhsan and Rizal [76] suggest that there is an increase in students' critical thinking skills in the classroom with problem-based learning rather than conventional classes. This is reinforced as well by Dwijananti and Yulianti [77] who reveal that critical thinking skills can be developed through the PBL learning model in several steps namely classifying, assuming, predicting, hypothesizing, evaluating, analyzing and drawing conclusions.

Figure 5 shows the average N-gain achievement of all students from all three schools. In the experimental class, there were 74 students in the medium category, 11 students in the low category, and 12 students in the high category. While in the control class, 53 students were in the medium category, 40 students were in a low category, and 4 students were in the high category. The calculation of normalized N-gain values in the experimental class showed 0.72 and was included in the high category. While the value of N-gain in the control class was 0.33 which belonged to the medium category. This proved that through the PBL model students were able to answer the questions given in learning through the activities of problem formulation, preparation of hypotheses, analysis, and concluding. Through these steps, it is hoped that students will be able to make a reasonable decision about what they are going to do. The learning process should be done by giving students critical questions as problems, which can make students have the ability to think critically as expected. Teachers are required to make changes following the expectations of the new educational paradigm through PBL models in teaching Science material.

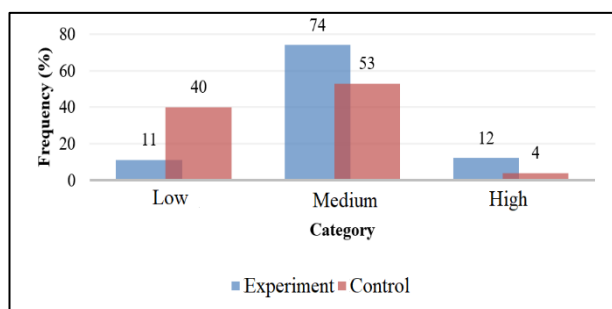


Figure 5. The average N-gain value for critical thinking

Critical thinking is related to thinking activities that make sense and are reflective in making decisions about what is believed to be done, through the steps of completing relevant hypotheses and drawing valid and useful conclusions in facing the real-life situation and the

world of professions [78]. The problem-based Learning model is seen as effective in improving students' critical thinking skills in natural science subjects [79]. PBL is an instructional strategy that allows students to develop critical thinking and problem-solving skills that are normally found in everyday life [80]. Through PBL, the teacher's time in using the lecture method will decrease, and learning becomes more meaningful because students experience real learning. In PBL, the teacher acts as a presenter, mentor, and facilitator for students in the process of learning science independently [81,82]. PBL is identical with the condition of students being more active and thus can develop various skills, such as teamwork, problem formulation, information discovery, discussion, explanation of new information to others, decision making, and formulation of conclusions [83,84]. If the ability to think critically increases, the learning outcomes can be achieved successfully [85].

Critical thinking needs to be fostered as a step to prepare students' skills to solve all existing problems in later life through life skills learning [86-89]. Life skills learning can provide a broad meaning if the activities designed in learning, especially in science classes, have a positive impact on students, and give meaning to broader life skills for work. Individuals must also skillfully evaluate the future consequences of their current actions and those of others. They have to be able to determine alternative solutions and analyze the influence of their values and the values of those around them [32,90].

In this development research, the presented material related to life skill was in the form of experimental steps to process tofu waste turned into *Nata de Soya*, which was delivered in the Life Skill integrated Science-PBL module. The process of learning science in junior high school is not only as fine knowledge and development of thinking skills, but the learning activities should be applicable, oriented towards learning skills, encouraging curiosity, building caring and responsible attitudes towards the surrounding environment [91-93].

Life skills are skills that are needed every day by someone to be successful in life [94,95]. Life skills also mean as the ability to adapt and have positive behaviors that enable a person to face all the demands and challenges in his/her life [11,96]. Students need to be equipped with various life skills which is a step in facing the challenges of global education. One component of life skills is the ability of students to think in high ordered level or think critically to deal with all the problems that possibly exist in life [97-102].

#### 3.1.4. Disseminate Stage

The disseminate stage is the stage at which the Life Skill integrated Science-PBL module that had been developed was disseminated to science teachers in other schools, namely in SMP Negeri 1 Kupang and MTs Al Ikhlas Soe, Kupang Regency, East Nusa Tenggara province. In the

early stages of dissemination, the research team also distributed a questionnaire consisting of 20 questions, representing the assessment aspects of the Life Skill integrated Science-PBL module. Overall, the responses of teachers from both schools asserted that the module was appropriate for use in science learning. The module is in valid, practical and effective categories.

Broader module dissemination needed to be done [103]. The developed module would be given and sent to secondary school teachers [104]. Requirements for dissemination are if the modules developed are valid, practical and effective, evaluated by module validators and trials have been conducted [105], because the research team is supposed to promote the dissemination of correct information in the community [106].

The dissemination was intended to expand the impact of the module usage on a larger number of teachers in various school contexts to produce educational changes [107]. Module dissemination was carried out by visiting several schools. The dissemination process was prioritized by explaining the description of the modules developed, so it was expected that teachers can utilize the modules in the form of softcopy or hardcopy. It was hoped by the team that the module would be used in classroom teaching practice [108]. The researchers also asked for contacts (e-mail and cellphone numbers) of the teachers to get feedback in the future, or if there is an implementation that needs to be accompanied. This is in line with the opinion of Orenstein et al [109], suggesting that researchers also need to conduct periodic outreach to respondents or audiences to determine whether any of them are considering implementing the given science and technology.

## 4. Conclusions

The results and analyzes of the study described that the Life Skill integrated Science-PBL module was declared valid and feasible to be used in Biology learning for Grade VII of secondary school students. The module can be effectively used in the learning process because it was able to improve students' critical thinking skills. This was indicated by the difference between the pretest and posttest scores which showed a significant increase. The Life Skill integrated Science-PBL module that was compiled had an average validation value of 3.97 and an N gain value in the experimental class of 0.72 and was categorized high.

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