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Characteristics of Evaluation-Process Biology Learning Tools Based on Conceptual Problem-Based Learning Models to Train Critical Thinking Skills

Herdiyana Fitriani[1], Taufik Samsuri[1*], Fida Rachmadiarti[2], Raharjo[2]

[1] Faculty of Applied Science and Technology, Universitas Pendidikan Mandalika, Mataram 83126, Indonesia
[2] Faculty of Mathematics and Science, Universitas Negeri Surabaya, Surabaya 60213, Indonesia

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Abstract: Critical thinking skills are very important to learn because it emphasizes how to invite students to find and build their own knowledge so that students can develop life skills and are ready to solve problems faced in everyday life. Critical thinking can be trained by applying learner-oriented active learning. Today the development of science and technology affects almost all human life in various fields. These developments make it easier for humans to access all information. In the world of education, the use of technology is very helpful for educators in developing learning so that educators can package and present material to be more quality and varied. The evaluative-process biology learning tool based on the conceptual-problem-based learning model that was developed is a directed, planned, and systematic effort to control the level of success of the learning process and can be integrated into a learning model syntax that can facilitate critical thinking learning. The purpose of this research is to produce a product in the form of an evaluative-process biology learning device based on a conceptual problem-based learning model to train students' critical thinking skills. This research is development research with specific targets to be achieved in this research, namely to produce evaluative-process biology learning tools based on valid conceptual-problem-based learning models to train students' critical thinking skills with components; Semester Program Plans (SPP), textbooks, Student Worksheets (SW), textbooks, and Critical Thinking Ability Test (CTAT) instruments to measure students' critical thinking skills. The results showed that all the elements that make up the device have been declared valid. The conclusion from the results of this further research can be the foundation for its implementation in the classroom, which is empirically expected to be effective in training students' critical thinking.

Keywords: Biology learning tools; Evaluative process, CPBL, Critical thinking

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Introduction

One of the life skills that need to be developed through the educational process is thinking skills (Amalya, et al., 2021). A person's ability to succeed in life is determined, among other things, by his skills in thinking, especially in an effort to solve the life problems he faces. Therefore, the Director General of Higher Education (2014) states that the criteria for learning achievement at the level of higher education (undergraduate) include the ability to think logically, critically, innovatively, quality and measurably. In this regard, critical thinking skills are seen as cognitive skills in interpreting, analyzing, evaluating, inferring, explaining, and self-regulating (Bailin, et al., 1999). This statement is in line with Facione (2011) which states that critical thinking skills are in the cognitive domain that determines the quality of decisions made by

*Email: taufiksamsuri@undikma.ac.id

someone so that it is very important to be developed in students. Based on this description, it is certain that critical thinking skills are skills that must be developed for students so that they are able to compete in the 21st century.

The results of a survey of researchers on critical thinking skills in students of the biology education study program Faculty of Science, Engineering and Applied (FSTT) Mandalika Education University (UNDIKMA) found that critical thinking skills in these students were very low because critical thinking had not been handled optimally, even though thinking skills could be integrated into all course material. In line with this, Facione in Nur, et al., (2013) recommends that critical thinking skills be used as a goal at all levels of the curriculum and teaching in particular. In addition, in the advanced placement exam program, critical thinking for students should also be developed. The problem of critical thinking skills does not only occur in FSTT Undikma, but also occurs in most universities in Indonesia and even occurs in other countries. One example of problems regarding critical thinking reported by Davies, (2011) that Australian higher education in the first two years of learning on campus there are 45% of students who do not experience a significant increase in critical thinking and reasoning skills and after four years of learning there are 36% of students did not experience a significant increase in critical thinking and reasoning skills. Through these facts, it can be understood that in addition to taking a long time, appropriate innovations in learning are needed to improve students' critical thinking skills, for example by applying a learner-centered interactive model.

Critical thinking skills can be taught through an interactive learning model centered on students using learning tools that are relevant to critical thinking attributions. Learning models that can facilitate critical thinking learning include Conceptual Problem Based Learning (CPBL). The CPBL model has been empirically declared effective for teaching critical thinking skills, but there are weaknesses in some critical thinking indicators such as evaluation and inference (Karmana and Samsuri, 2018; Wahyuni, et al., 2021). These problems can be solved through evaluative processes that are integrated in learning using the CPBL model. The evaluative process is a directed, planned, and systematic effort to control the success rate of the learning process and can be integrated into the syntax of the learning model (Arifin, 2012; Rahman, et al., 2021; Menap, et al., 2021).

The learning process in higher education that focuses on the transfer of information is an important supporting factor for developing learning tools that have the characteristics of systematic knowledge construction (Fitriani, et al., 2018; Priska, et al., 2021). Learning devices are one of the factors that play an important role in teaching and learning activities. The development of learning tools in accordance with the characteristics of teaching materials and learning models tends to have an impact on directed learning so that the general goal of education, namely optimizing the skills of students, can be achieved (Akbar, 2013; Fitriani and Ikhsan, 2018; Ilfiana, et al., 2021).

Based on the description of the background above, it is very important to train students' critical thinking skills through innovative and learner-centered learning to develop learning tools that explicitly aim to train students' critical thinking skills which in this research are conceptual-problem-based evaluative-process models. learning is used as a learning model that is integrated in learning tools that are developed as an effort to prepare students who are knowledgeable, capable, critical, creative and innovative according to the demands of higher education. Critical thinking is also the basis for forming creative and innovative personal learners (Liliasari, 2009; Liliasari, 2013; Khairati, et al., 2021). The purpose of this study is to develop a valid evaluative-process biology learning tool based on a valid conceptual-problem-based learning model to train students' critical thinking skills which includes SPP, textbooks, SW, CTAT instruments, and rubrics for assessing students' critical thinking skills.

Method

This type of research is development research to produce products in the form of evaluative-process biology learning tools based on conceptual-problem-based learning models to train students' critical thinking skills that are valid, practical and effective. The tools developed are SPP, SW, textbooks, test instruments and rubrics for assessing critical thinking skills.

This research procedure is divided into two stages, namely the development stage and the implementation stage (trial) of learning devices. The development stage of learning tools that will be developed is an evaluative-process biology learning tool based on a conceptual-problem-based learning model to train critical thinking skills by integrating theory Plomp & Nieveen, (2010), about the criteria for a quality product covering three criteria, namely validity, practicality, and effectiveness. The practicality and effectiveness (implementation) stages of the research were not carried out. The implementation of the learning device uses the One Group Pretest-Postest Design with 30 students as subjects. The first step is to measure the initial test, then subject to treatment within a certain period of time, then a final test is carried out.

The observed variables are (1) the feasibility of the learning device developed by using validation techniques by experts. The results of the validation are then revised by researchers based on input from experts. (2) Critical thinking skills using tests. The test given is a product learning outcome test to measure students' critical thinking skills. The test was carried out in two stages, namely the pretest was given at the beginning and the posttest was given at the end of the lesson. (3) Observations were made to obtain data on the implementation of learning and student activities during the learning process which were observed by two observers. Questionnaires were given to measure students' opinions and responses to the learning activities that were followed and the level of readability of the material in textbooks and SW. Furthermore, the data obtained in the form of validation results, readability of SW and teaching materials, implementation of lesson plans, activities, learning outcomes, student responses, and students' critical thinking skills were then analyzed descriptively quantitatively.

Result and Discussion

Result

This development research was carried out in two stages, the first stage was the development of learning tools and the second stage was followed by a limited-scale trial. In the following, the results of the development of evaluative-process biology learning tools based on the conceptual-problem-based learning model will be presented to train students' critical thinking skills.

The learning tool developed is an evaluative-process biology learning tool based on the conceptual-problem-based learning (e-CPBL) model to train students' critical thinking skills. The learning tools developed in this study include: Semester Program Plans (SPP), Student Worksheets (SW), textbooks, test instruments and critical thinking skills assessment rubrics. The device was validated using a validation instrument.

The tools that have been developed in this study were validated by experts in the field of biology and biology education. The purpose of this validation is to make the learning tools developed suitable for use, and to support the learning process according to the characteristics of the material.

Semester Program Plan (SPP)

Semester Program Plan (SPP) is a guideline designed systematically to describe scenarios for presenting learning materials in accordance with the learning stages used in the research, namely evaluative-process based on conceptual-problem-based learning models. The SPP developed by the researcher was designed in three meetings.

The developed SPP contains (1) Education Units; (2) Competency Standards (CS); (3) Basic Competence (BC); (4) Indicators; (5) Learning Objectives; (6) Time Allocation; (7) Learning Models and Methods; (8) Subject matter; (9) Tools and Materials; (10) Learning steps for blended community of inquiry; (11) Learning Resources; (12) Critical Thinking Skills Assessment. The results of the RPS validation can be seen in Table 1.

Table 1 SPP Validation Results

No	Rated aspect	Average Rating			Average	Category
		V1	V2	V3		
1.	SPP Components	3.69	3.69	3.62	3.67	Very Valid
2.	SPP Writing	3.29	3.29	3.71	3.43	Valid
Validaty (SPP)		3.60				Very Valid
Reliability (SPP)		90%				Reliable
Conclusion**:** The developed SPP is valid for use by teachers in learning.						

Based on the data in Table 1. the results of the validation by the validator on the aspect of the SPP component developed by the researcher have a very valid category, with an average score of 3.6 in the very good category. The results of the calculation of the reliability of 90%. SPP with categories suitable for use as a learning tool with little revision or improvement. The validator's suggestions for the developed SPP are listed in Table 2.

Table 2. Validator Suggestions about SPP

Tools Name	Revision Source	Suggestion
SPP	Validator	In SPP 01 Cognitive Assessment Sheet Question No. 3, it is recommended to adjust to critical thinking indicators In SPP 01, the three critical thinking indicators, making, should be replaced with designing.

Student Worksheet (SW)

The Student Worksheet (SW) that has been developed in this study is a student guide in conducting concept/principle/solution discovery activities in learning activities. In this e-CPBL SW, it presents an experimental/observation procedure. In addition, in this SW, there is a concept understanding section so that it can help students carry out discovery activities in the experimental process which is directed to be able to train students' critical thinking skills.

The SW in the experimental section contains several parts, namely: (1) problem formulation; (2) hypothesis; (3) variables; (4) definition of rational variables: (5) experimental planning: (6) experimental results; (7) description of the experimental results; (8) questions; (9) conclusion. The Student Worksheet (SW) that has been developed by this researcher is then validated by the validator and the results of the SW validation can be seen in Table 3.

Table 3. Results of Student Worksheet Validation

No.	Rated aspect	Rating Score			Average	Category
		V1	V2	V3		
1.	Procedure Clarity	3	4	4	3.70	Very Valid
2.	Readability/Language	4	4	4	4	Very Valid
3.	Conformity of instructions with curriculum, learning objectives with references	3	4	4	3.70	Very Valid
4	The implementation procedure is in accordance with e-CPBL learning	3	3	3	3	Valid
Total score	13		15	15	14.40	
Validity	3.60					Very Valid
Reliability	90%					Reliable
Conclusion: The MFI developed is valid for use in learning.						

Based on the results of the validation of Table 3, it is known that overall, the MFI developed by the researcher has a very good validity category, with an average score of 3.6 so that it can be used without revision. However, if viewed from the implementation procedure, there are still slight revisions or improvements so that they can be used in the learning process. Inputs or suggestions from validators are listed in Table 4.

Table 4. Suggestions from validators on SW

Tool Name	Revision Source	Suggestions/Revisions
SW	Validator	In the implementation procedure section, it is enough to be directed to make your own, or you can also add dots so that students can continue in compiling procedures. At the beginning, it should be equipped with critical thinking indicators that are measured before the objective of the observation.

Textbooks

The textbooks that have been developed by the researchers cover the taxonomy of phanerogam. This textbook was developed by researchers to be able to train students' critical thinking skills which include a number of problems in students' daily lives.

This student textbook contains a number of discussion materials in accordance with the measured indicators which are expected to assist students in training or developing students' critical thinking skills. Student textbooks are descriptions that function as study guides, both during the learning process in class and independent study. The assessment carried out by the validator on the student module includes four aspects of assessment, namely the feasibility of content, presentation, language and legibility, adjustment to the conceptual problem-based learning tool, the results of which can be seen in Table 5.

Table 5. Textbook Validation Results

No.	Rated aspect	Average Rating			Average	Kategory
		V1	V2	V3		
1.	Content Eligibility	3.33	3.33	3.59	3.38	Valid
2.	Presentment	3.38	3.38	3.50	3.42	Valid
3.	Language and legibility	3.33	3.83	3.67	3.61	Very Valid
4	Compatibility with e-CPBL learning	3.33	3.44	3.56	3.44	Valid
Validity		3.50				Valid
Reliability		87%				Reliable
Conclusion: The module developed is valid to be used as a guidebook in the learning process.						

Based on the data in Table 5. it is known that the student textbooks developed by the researchers have a valid category with an average score of the four aspects of the assessment, namely the feasibility of content, presentation, language and readability, adjustment to e-CPBL learning is 3.5, with valid categories, so it can

be used with minor revisions or improvements. The results of the calculation of the reliability of 87%. Thus, the textbook can be categorized as suitable for use as a student guide. The validator's suggestions and input on student textbooks are listed in Table 6.

Table 6. Suggestions and input from the Validator regarding textbooks

Device Name	Source Revision	Suggestion/Revision
Textbooks	Validator	The source should be written in the image, and the source is placed after the image caption The material should be added again in each chapter so that it has a good depth of material.

Test Instruments

Instrument critical thinking test is a collection of questions that are used to measure students' critical thinking skills which are developed based on learning objectives and indicators. Instrument The test developed was in the form of a description test to measure critical thinking skills with 10 test items, which were developed based on the specification table. The results of the validator assessment can be seen in Table 7.

Table 7. Validation Results of Critical Thinking Ability Test Instruments

Question Number	Rated aspect									
	Content Validity					Language Validity				
	Evaluation			Average	K	Evaluation			Average	K
	V1	V2	V3			V1	V2	V3		
1.	4.00	4.00	4.00	4.00	SV	4.00	3.00	3.00	3.33	V
2.	4.00	4.00	4.00	4.00	SV	4.00	3.00	3.00	3.33	V
3.	4.00	4.00	4.00	4.00	SV	4.00	4.00	3.00	3.67	SV
4.	3.00	4.00	3.00	3.33	V	3.00	3.00	3.00	3.00	V
5.	4.00	4.00	3.00	3.67	SV	4.00	3.00	3.00	3.33	V
6.	4.00	4.00	3.00	3.67	SV	4.00	4.00	3.00	3.67	SV
7.	4.00	4.00	3.00	3.67	SV	4.00	3.00	3.00	3.33	V
8.	3.00	4.00	3.00	3.33	V	3.00	3.00	3.00	3.00	V
9.	3.00	4.00	3.00	3.33	V	3.00	4.00	3.00	3.33	V
10.	3.00	4.00	3.00	3.33	V	3.00	4.00	3.00	3.33	V
Average	3.67	4.00	3.33	3.63	SV	3.67	3.40	3.00	3.33	V
Reliability = 89.76% with reliable category										
Conclusion: The test that has been developed is valid as an instrument to measure students' critical thinking skills										

Information: K: Criteria; V: Valid; SV: Very Valid V1: Validator 1; V2: Validator 2; V3: Validator 3

Based on Table 7 above, on average it shows that from the aspect of the content of this device it gets a score of 3.67 and the test questions are declared very valid, from the aspect of language and writing the questions get a score of 3.33 and are declared valid so that they can be used in learning, and the results of calculating reliability are overall 89.76%. From the results of the assessment, the questions are categorized as suitable to be used to measure students' critical thinking skills. The validator's suggestions and input on CTAT developed by researchers are listed in Table 8.

Table 8. Suggestions/inputs from the Validator regarding the Student's Critical Thinking Ability Test

Tool Name	Revision Source	Suggestions/Revisions
Critical Thinking Ability Test	Validator	In questions containing the name of the species, it should be written in italics The use of pictures and symbols of the flower formula should be consistent with those in the module.

Discussion

Semester Program Plan (SPP)

The SPP developed consists of identity, BC, CS, indicators, objectives, learning models, and learning syntax. The lesson plans are structured to teach Plant Taxonomy with evaluative-process biology learning based on conceptual-problem-based learning models to train students' critical thinking skills. The learning steps refer to the evaluative-process biology learning model based on the conceptual-problem-based learning model. As revealed by Garrison in Plomp & Nieveen, (2010) that the evaluative-process biology learning model based on the conceptual-problem-based learning model was developed by adapting an inquiry learning model that emphasizes asking activities, independent learning, experimenting, and reflection on learning

experiences. Learning management by practicing critical thinking skills through evaluative-process biology learning based on the conceptual-problem-based learning model can be seen from the implementation of SPP in the learning process which is focused on each stage of evaluative-process biology based on the conceptual-problem-based learning model developed. SPP development is carried out to achieve the expected learning objectives.

Based on Table 1. the results of the SPP Assessment Validation, which include aspects of the objectives, learning steps and methods presented with an average of 3.6 categories are very good and feasible to use. The achievement of this quality is due to the development of this tool has gone through several stages, namely needs analysis, student analysis, concept analysis, task analysis, and a review of the validator. The results of this study are supported by the opinions of Nur, et al., (2013) who say, learning tools are said to be: (1) not good if they have a value of 1.00 to 1.99; (2) not good if the value shows 2.00 to 2.99; (3) quite good, if it shows a value of 3.00 to 3.49; (4) good, if it shows numbers 3.50 to 4.00. The average score generated at each stage of guided discovery that has been carried out is between 3.3 to 4.0. The resulting research data needs to be calculated for its reliability. Reliability will refer to an understanding that an instrument is reliable enough to be used as a data collection tool because the instrument is already good. A good instrument is an instrument that is not tendentious which directs respondents to choose certain answers (Rahmadita, et al., 2021; Rizki, et al., 2021). An instrument is said to be reliable (good), if its reliability is equal to or more than 75% (Shirali, et al., 2018). The results of the calculation of the reliability of the evaluative-process biology learning management instrument based on the conceptual-problem-based learning model in the second trial 90% (Table 5). The instrument used in learning management is said to be reliable, so that the resulting data of learning management can be trusted and relied upon (Shirali, et al., 2018).

Student Worksheet (SW)

The student activity sheet (SW) that was developed aims to practice critical thinking skills, with the hope of helping students conduct experiments independently. Learning materials that provide student-centered activities can be packaged in the form of SW. The selection of learning materials should be based on the understanding that these learning materials provide student-centered activities. In this description, the researcher hopes to help students conduct experiments independently after being guided by evaluative-process biology learning based on the conceptual-problem-based learning model to train students' critical thinking skills. The SW is developed to train critical thinking skills, namely: formulating problems, formulating hypotheses, determining variables, defining variables, designing experiments. Determine variables, define variables, make observations, analyze, draw conclusions.

The results of the validator assessment consisting of aspects of procedural clarity, legibility, conformity of instructions with learning objectives, implementation procedures in accordance with evaluative-process biology learning based on conceptual-problem-based learning models received an average score of 3.6 with 90% validity (Table 5). This shows that the developed SW is in good category and is suitable for use by students and lecturers in practicing critical thinking skills, with the developed SW assessment instrument having a reliability of 90%, so the SW used is reliable.

Based on the explanation above, the SW that has been developed can be used in biology learning in the General Biology course. Furthermore, the development of this SW can be a reference for lecturers and other developers to develop an SW that is oriented towards evaluative-process biology based on a conceptual-problem-based learning model.

Student Textbook

The preparation of student textbooks refers to the BC and CS in the SPP according to what was compiled. Student textbooks were developed related to those programmed by KKNI, namely that textbooks must refer to the applicable curriculum, oriented to process skills using contextual, technology and community approaches, as well as demonstrations and experiments. The standard for assessing textbooks is also adjusted to the standards for assessing the development of textbooks by looking at three main aspects, namely: content, presentation, and readability.

As a guide and one of the learning resources for students in studying the taxonomy of phanerogamae which was developed with evaluative-process biology learning based on the conceptual-problem-based learning model, it has steps that are in accordance with the development objectives, so that in carrying out learning activities in the classroom and learning independently, students can find information or answers needed in finding concepts and in solving problems they face. As the opinion expressed by Pedaste et al., (2015) states, in general, an investigation is a process of finding out by seeking knowledge and understanding. This can be done in various ways such as observing nature, predicting outcomes, manipulating variables, passing questions, and seeking answers.

The results of the validator's assessment are based on four aspects, the average content feasibility aspect is 3.4, the presentation aspect is an average of 3.4. The average language and readability were 3.6, and the

overall mean result was 3.5 with a reliability of 87% (Table 5). From the results of the assessment, the student module is feasible and reliable as a guidebook for students in practicing critical thinking through evaluative-process biology based on conceptual-problem-based learning models.

Test Instruments

The learning outcomes test sheet is used to measure the achievement of basic competencies that are determined based on the completeness of indicators, an indicator is said to be complete if 75%. Students are said to have mastered the basic competence (if all the indicators on the basic competence are complete. Critical thinking skills test is an evaluation tool developed by researchers to measure the achievement of student learning outcomes in the form of critical thinking skills. This test instrument was developed in the form of descriptive questions based on indicators or learning outcomes that had been formulated previously.

The validation carried out by 3 validators on the critical thinking skills test instrument gave results as presented in Table 7. From the table it is known that the average value of validation is 3 with a reliability of 78%, this shows that the critical thinking skills assessment sheet developed by the researcher is suitable to be used as a measuring tool for critical thinking skills.

Conclusion

Based on the results of the validation of learning tools by expert validators, sequentially the average value of the validity of each component of the device, namely, SPP 3.6 (valid categories); SW 3.6 (very valid categories), textbooks 3.5 (valid categories) and TKBK 3.33 (valid categories), it can be concluded that the blended community of inquiry learning tool developed is valid for use in learning.

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