Effectiveness of concept-based learning model, drawing and drill methods to improve student's ability to understand concepts and high-level thinking in animal development course

Lufri, Rahmadhani Fitri, Relsas Yogica
Biology Department Lecturer, Mathematic and Natural Science Faculty Universitas Negeri Padang, Indonesia
E-mail: lufri.unp@yahoo.com

Abstract. The demand for the quality of education is increasingly sticking with various forms. Government and higher education have a strong share in this implementation, through the application of quality lectures. Animal development is one of the subjects in the Department of Biology FMIPA Universitas Negeri Padang. Based on the observations that the research team has done quite high, consequently low learning outcomes as well. So, researchers have built a model as one solution to that. This model is a concept-based learning model, drawing and drill method. This research is a development research on product effectiveness test stage. This stage is implemented by applying the model in the lecture then the value of student learning outcomes in the form which is a combination of semester exam, semester final exam and the value of the task. The results showed the average student is 73 (class B). Based on the results of this study can be concluded concept-based learning models, drawings and methods.

1. Introduction
The demand for improving the quality of higher education from shareholders has surfaced in various mass media and various educational forums. To respond to these demands has been made to share serious efforts by the government and various implementers of higher education. Some aspects that are closely related to the quality of education is the quality of the learning process, which is expected to be an important factor of the formation of individuals who are able to apply science properly and correctly. Preliminary research results in one of the courses, namely the Animal Development showed unsatisfactory results. The findings obtained are the weakness of the students to understand the existing concepts, the difficulties of the students to re-explain the related material, the difficulties of students describing the picture and the inability of high-level thinking students.

The problem of quality of learning is certainly closely related to the relatively low ability of students to understand the concepts of animal development. The relatively low ability of students to understand the concepts of animal development is known when they take the final exam of the semester. Often students answer incorrectly, one or more material-related concepts, of which the material should not be answered incorrectly. From this condition it is implied that students are less understanding about what they make, as if they just memorize written sentences in a reading book without understanding anything.
Based on the facts mentioned above, reinforced the results of several discussions with the team of animal development courses, then came the idea to overcome the problem or find a solution about the low understanding of students on the concept of animal development that resulted in relatively low quality of learning and low student learning outcomes. The solutions offered through this research are Concept Based Learning Model, Drawing and Drill Method. In the previous research, the research team has come to test the validity of the model and the Student Worksheet. So it takes further action to improve the quality of the model by implementing effectiveness test on the students of Department of Biology FMIPA Universitas Negeri Padang. The benefits of this research is to increase the level of confidence of the scientific community and society in general to the products that have been developed.

2. Literature Review

2.1. Concept Based Learning

Concepts have varying definitions in the psychology and education literature. Some definitions emphasize the general properties of objects and events to recognize them. Concepts can occur at different levels from the general to the more specific. Concepts can be represented by a hierarchical relationship [1]. Concepts can be defined as mental organization and categories of thought or idea. As a category, concepts have categories that include objects, events, people, ideas, and symbols [2]. A concept is not the same as a word. The word is a symbol of a concept or a way of expressing concepts. The concept is essentially an idea or an understanding of something or generalization [3]. Learning-based concepts will become meaningful when using concept maps. A concept usually does not stand alone, it will deal with other concepts. The relationship between one concept and another can be illustrated by the concept map.

Concept maps are diagrams that show the interconnectedness between concepts as a representation of meaning. The concept map was developed by Novak in 1972. The development of this strategy was based on the Ausubel assimilation theory of 1963. Concept maps were applied to several subjects and to several levels in the subject [4]. The main stages of the concept map are: (1) listing key concepts and ideas in the form of words or phrases, (2) constructing such key concepts and ideas in a hierarchy, ranging from the most general, inclusive and abstract (superordinate) to the most specific and concrete (subordinate), and all of these are developed with arrow lines, and (3) putting this word or phrase in the proper position and connected with lines and arrows to form a prepositional or propositional form [4].

Meaningful learning is a mental process of new information that is associated with previously possessed knowledge [5]. According to Ausubel's theory of learning (Theory of Cognitive Assimilation), new concepts will mean when connected with other concepts. Meaningful learning will occur when new knowledge is associated with existing concepts in the child's cognitive structure [6].

No one denies that concept development is an essential component of a meaningful learning process in Biology. To understand Biology is not enough to learn the facts alone. Separate pieces of information will be easily forgotten as quickly as the material is learned. Materials will be useful if they contribute to the development of basic concepts emphasized in biological disciplines. Learning that stresses the concepts in the field of biology is better than studying discrete facts. Learning with the conceptual approach will lead to meaningful learning and enable easy understanding of the material and help remember the subject matter. Therefore, it is suggested the use of conceptual approach in teaching biology [7]. Ausubel has not found a strategy that can be used for meaningful learning. Later, Novak [8] found one meaningful learning strategy known as the concept map.

Novak reported the results of his research that concept mapping can improve meaningful learning. On the other hand, Alaiyemola, Igede & Okebukola reported some research results showing that concept mapping can help learners deepen and gain metacognition [4]. Esiobu and Soyibo [1] reported that making concept maps can make children learn meaningful thus significantly improving learning achievement for predegree students in genetics and ecology.
The results showed that concept maps related to meaningful learning, meaningful learning related to learning outcomes. Therefore, many studies have found that creating concept maps in learning can improve learning outcomes. For example, the concept map prepared by students, then presented and discussed turned out to occur meaningful learning that ultimately improve learning outcomes. Furthermore, at the end of the lesson it can be seen that all students show an increased interest in understanding more about science [9].

2.2. High Thinking Order
According to Lewy, et al. [10] the learning process in the classroom should be able to train high-ability learners. One of the learning process that is able to train high-ability learners is by learning that familiarize the learning process based on the problem, invites learners to always explain and maintain the process and the results of his work from critics given his friends, familiarize students solve problems with various strategy (open ended approach) and invites them to evaluate these strategies in terms of their effectiveness and efficiency as well as performing reflective practices (by making learning journals).

High-level skills are skills that can be trained [11]. This ability can be trained to be improved but there are several factors that influence the improvement in each individual according to the intelligence of each individual. She added that this high-level ability can be trained one of them with the learning process using Problem Based Learning model where learners will be trained to reveal ways as an alternative to solve the problem [11]. A person to be successful at school, workplace or in life needs to have and practice differentiated thinking skills such as remembering, comparing, classifying, drawing conclusions, generalizing, evaluating, experimenting and analyzing. Skills that can be taught to learners directly. She also said that the ability of critical thinking and creative thinking is an indicator of high-level thinking ability [11]. The development of critical thinking and creative thinking will not be separated from the development of left and right brain performance capabilities requiring continuous training that can be done through the learning of all fields of study. Critical thinking is one of the higher-order thinking processes that can be used in the formation of a student's conceptual system.

According Patandean and Lumbu [12] based on his research found that learners who learn using problem-based learning model is better than students who use the usual modeling. Learners who use problem-based learning emphasize student activity to construct their own knowledge. In this problem-based learning, students actively engage in discussion activities. Discussion activities in this learning force students to interact and is one to train high-ability students. In this problem-based learning also shows high creativity in solving the problems given to learners. This can be seen from the many variations of ideas expressed by learners as well as learners do not quickly give up any solve problems given. Frequently asked questions and discussions in conveying ideas or opinions make the learning atmosphere feel very excited.

The advantages of a critical thinking learning program can be described as follows. First, learning is based on learners [13]. This can be seen from the learning phases designed to provide more opportunities for learners to explore to find answers to problems that have been formulated in the learning phases. Second, this learning model can increase knowledge, skills, and can develop positive attitude of learners. This can be seen from the increased mastery of concept and critical thinking skills, and appreciate the opinions of friends acquired during the learning. Third, the description of learning critical thinking skills begins with open-ended problems and conceptual questions with the help of student worksheets, related questions between concepts so that important concepts are discussed comprehensively. Fourth, procedural questions are used to develop an understanding of the concept and critical thinking skills of students, this question helps students to construct their knowledge.

2.3. Images in Learning Process
In education, the old paradigm of teaching and learning comes from theory. We are familiar with John Locke's tabular theory. He said that the mind of a child is like a blank white paper and ready to receive
the scribbles of his teacher. Based on this theory many teachers implement teaching and learning process as follows: (1) transfer knowledge from teacher to student, (2) fill empty bottle with knowledge, (3) classify students, (4) force students to compete.

The condition of education has changed a lot, so the demands of learning also changed. Therefore, the paradigm of education and learning must also change according to the development of science and technology and the demands of the times. Some theories and thoughts that led to the birth of a new paradigm of education and learning have emerged such as: (1) knowledge is found, formed and developed by students, (2) students actively build knowledge, (3) educators in charge of developing the competence of students optimally, (4) learning occurs through the interaction between students and students and between students and teachers, as well as between students and the environment. Based on the new paradigm of learning then came the various models of learning developed by experts in their field [14].

Picture is a visual communication design that has a primary purpose in order to get the attention of everyone who sees. There is no purpose other than an image except shouting "look at me!" Or "read me, now!" [15]. Visual communication design is said to be effective if it can attract the attention of readers. When passing on the highway, the eyes will turn to a billboard. Unconsciously, the eye is drawn to see a unique and unexpected picture. Seconds later, eyes like hypnotized to read the text.

In learning, drawing is very important to be used in an effort to clarify the understanding of the students because as a visual communication tool the image can provide a wider knowledge to the students [16]. By using pictures of learners can pay more attention to objects and things that have never seen related to learning [17]. Brown [18] states, "Properly selected and adapted images will help students understand and remember the information content of the accompanying verbal materials."

Images can help to achieve instructional goals, because images include easy and inexpensive media and greatly enhance the value of teaching. Because the drawing, experience and understanding of learners become wider, clearer and less easily forgotten, as well as more concretely in the memories and associations of learners [17]. The images can be collected from various sources such as calendars, magazines, newspapers, pamphlets from travel agencies, and so on. Images should be collected in folders by certain categories to be easily searchable if necessary [19]. The benefits of images in the instructional process is the delivery and explanation of information, messages, ideas and so forth with no much use of verbal language, but can give the impression more.

2.4. Drill Method

Drill methods are generally used to gain the dexterity or skill of what has been learned. According to Sudjana [20], reasonable exercises are used for things that are motoric, such as writing, games, making, and others. Then, drill methods can also be used to train mental skills, train relationships, responses, and so on. One of the principles that need to be considered in using this drill method is that students should be given a deep understanding before the exercise.

According to the theory of education Gal'perin the learning process can be described as a series of four stages, namely: (1) Students oriented to the elements of important science, including ways of reasoning typical for the field of science. (2) Students practice thinking through their relationship between one object or activity with others. (3) Students get awareness of the learning outcomes (feedback) that have been achieved. (4) Students continue the learning process by orientation.

When students are expected to understand the theory described, especially if they have to master the material given, and especially if they must be able to apply the theory then it takes practice or need to apply drill methods in learning. It should be noted that the exercise will work well when students are accompanied in the learning process and the learning process is maintained by the teacher [21].

3. Method

This research is a development research that is at the stage of effectiveness. This stage is a field test to the subject of research. The test subject is a student who is taking the subject of Animal Development in Biology Department FMIPA Universitas Negeri Padang. In this research there are two variables that
become focus, that is independent variable and dependent variable. The independent variable is a concept-based learning model, drawing and drill method. Meanwhile, the dependent variable is the result of student learning. The data analyzed is data of effectiveness of learning model. Data source of effectiveness is the subject of the test students.

4. Result and Discussion

Table 1. Students Learning Result

| No | Program            | Half Exam | Last Exam | Task | Average |
|----|--------------------|-----------|-----------|------|---------|
| 1  | Education Biology D| 76        | 64        | 84   | 75 (grade B) |
| 2  | Biology C          | 62        | 64        | 84   | 70 (grade B) |
|    | **Average**        |           |           |      | **73 (grade B)** |

Table 1 shows the distribution of the value of the students who have conducted the lecture using the learning model that has been developed in this research. The average student score is 73 with grade B. No one student gets a C grade. This shows the learning model developed effectively to create quality learning. Individually and classically, concept-based learning, drawing and drill methods used in the Animal Development program are able to produce students with satisfactory learning outcomes. The calculation of student learning outcomes aims to determine the level of student achievement in quantitative manner each student after following the lecture with this model. The cognitive learning outcomes are obtained by calculating the combination of the value of the assignment, the mid-semester value and the final grade of the semester.

Concept maps can give positive things for the lectures. Students can arrange and know the relationship between concepts. The concept can be presented by the lecturers themselves, also by the students as a form of assignment. This assignment supports the drill method which is also part of the research variables. Learning by using concept maps, students have the ability to assemble the concept of the course well. So, they become trained to learn independently and have meaningful learning experiences. Especially if the learning by using concept maps assisted by technology. The use of technology to create concept maps can improve the level of self-regulated learning of students better than the manufacture of concept maps manually [22]. This positive improvement of student learning process becomes the reason for good learning value. In addition to creating concept maps, it can also be applied by requesting feedback from students. The feedback will improve understanding of concepts [23].

Meaningful learning is formed by applying this developed learning model. Meaningful learning will not only improve student learning outcomes, but also the knowledge they gain during learning will be well attached. Students are happy to learn because the learning that they follow feels interesting. If students feel happy to learn the learning outcomes will be good [24].

Meaningful learning can occur because students learn to explore their knowledge and abilities. This exploration of knowledge and ability emotionally leads the students to achieve meaningful learning [25]. The ability to think creatively and critically is one factor that also supports the formation of meaningful learning. The ability to think creatively and critically become a key factor of innovation today [26].

In addition to meaningful learning, students are also trained to think high level. This is supported by the ability to think critically and creatively that has been formed. High-level thinking will be achieved by students who have good self-regulated learning. The formation of SRL is supported by concept-based learning models and drill methods as well as those described previously. The ability to think high-level can be obtained by students who understand their in-depth learning strategy [27].

5. Summary
The developed learning model has produced students with good learning outcomes. That is, this model is effectively used to solve student problems during the learning process. It is expected that with the information on the results of this study, the reader can know that the model developed effectively used
in learning with the same problem of this research.

References

[1] Sayibo K 1995 The American Biology Teacher 57 344
[2] Setyosari P Sumber Belajar 57
[3] Kolesnik W B 1976 Learning, Educational Application (Boston: Allyn and Bacon, Inc)
[4] Okebukola P A 1992 Research in Science & Technological Education, 10 153
[5] Slavin R E 1994 Educational Psychology: Theory and Practice (Boston: Allyn and Bacon)
[6] Ausubel D P 1968 The Psychology of Meaningful Verbal Learning (New York: Grune & Stratton)
[7] UNESCO 1986 Unesco Handbook for Biology Teachers in Asia (New Delhi: Pearl Offset Press Pvt. Ltd)
[8] Novak J D and Gowin D B 1985 Learning How to Learn (New York: Cambridge University Press)
[9] Mason C L 1992 Science Education, 7651
[10] Lewy, Zulkardi and Nyimas Aisyah 2009 Jurnal Pendidikan Matematika 3 14
[11] Kurniawati and Wahyu 2014 Elementary School I 1 55
[12] Patandean, Usman and Albert Lumbu 2014 Jurnal Ilmu Pendidikan Indonesia 2 10
[13] Widiyowati and Intan I 2014 Proc. Nat. Conf. Chemistry (Indonesia) (West Kalimantan: Indonesia) 1
[14] Lufri 2007 Strategi Pembelajaran Biologi (Padang: UNP Press)
[15] Supriyono and Rahmat 2010 Desain Komunikasi Visual (Yogyakarta: Andi Offset)
[16] Sanjaya and Wina 2010 Strategi Pembelajaran Berorientasi Standar Proses Pendidikan (Jakarta: Prenada Media Group)
[17] Rohani and Ahmad 1997 Media Instruksional Edukatif. (Jakarta: Rineka Cipta)
[18] Brown J W 1977 Technology, Media and Methods (New York: McGrawhill Book)
[19] Nasution 2005 Teknologi Pendidikan (Jakarta: Bumi Aksara)
[20] Sudjana N 2002 Dasar-dasar Proses Belajar Mengajar. (Bandung: Sinar baru Algensindo)
[21] Utomo T and Ruijter K 1985 Peningkatan dan Pengembangan Pendidikan (Jakarta: Gramedia)
[22] Stvenson M P et al. 2017 Educational Research Review 21 1
[23] Finn and Bridgid 2017 Learning and Instruction 0 1
[24] Davoudi, Mohammad A H and Parpouchi A 2016 Proc. Int. Conf. Organization and Leadership (Dubai) 184
[25] Konstiaienen E et al. 2018 Teaching and Teacher Education 71 66
[26] Wechsler S M et al. 2017 Thinking Skills and Creativity 27 114
[27] Lee J and Choi H 2017 Computers and Education 115 143