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Scientific Approach to Build Students' Scientific Attitudes and Its Effectiveness toward Their Achievement in Physics

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Abstract. Basically, classroom activities are intended to guide students to understand the basic concepts of physics. In the same time, those activities should be planned to prepare the students to face their daily life. The learning process should be designed in such a way to make positive attitudes such as curiosity, responsibility, honesty, openness, and cooperation grown through physics learning. However, many teachers tend to neglect this aspect of education and give priority only to the students' understanding in physics concepts. This research' aims were to comprehend about the using of scientific approach to build students' scientific attitudes. It also wanted to know the effectiveness of the learning program toward the students' achievement as well. The research design was a pre-post one group quasi experiment. The program implementation was conducted in a group of 18 students in a State Junior High School in Ambon. Those students had been chosen purposively. The group had been taught with discovery learning instruction. The data had been analyzed qualitatively and using t-test formula. The students' scientific attitudes scores that had been observed were curiosity: 84.7; critical thinking: 86.1; honesty: 95.8; responsibility: 100; and cooperative: 93.8. The average of the students' achievement was 86.9, which means very good. The counting of t_{value} is 35.95, which is more than the t_{table} = 2.10. The results showed that scientific approach can be used to build students' scientific attitudes. The using of scientific approach is effective towards the students' achievement

Keywords: scientific approach, scientific attitudes, students' achievement, physics education

INTRODUCTION

Years ago, the purpose of science education was to train small numbers of people to become scientists. Recently, science education is needed to make more people scientifically literate in order to face the global challenges [1]. That statement is similar to the goals of the Indonesia National Education which is to develop students' potentials to become faithful and devoted to God Almighty, noble, healthy, knowledgeable, skilled, creative, independent, and become citizens of a democratic and responsible. The efforts to achieve these goals have been pursued by various components. One way of the Indonesia's government to go after these goals is by making reforms in the curriculum. The learning in the recent curriculum is designed to be student-centered. This means students have to perform various activities in a learning session.

The spearheading of the implementation of a curriculum is a teacher. Therefore, a teacher must be able to design an effective, fun, and meaningful learning. In addition, a teacher also needs to be able to implement his/her learning program in the classroom so that the targeted objectives can be achieved. A teacher should create a variety of

students' activities that will help the students to understand the concepts since if they only listen to the teacher's explanations that would be very difficult. Students should be actively involved in the learning process to find the concept. The discovery of the concept by students can occur through experiments in the classroom or in the laboratory, or in a group discussion. To reinforce the new concept, the students can be trained to solve problems [2].

In addition to develop students' cognitive abilities, the undertaken activities should be used by teachers to grow and encourage various scientific attitudes as the character formation of the students. Based on the facts that occur in many classrooms, most teachers ignored the character formation of students in the learning process. There is a tendency of teachers to prioritize the achievement of the learning objectives in the cognitive aspect only. Student activities that should be intended for the development of various scientific attitudes are rarely encountered in the process of physics learning at schools. Not only knowledge (cognitive) aspects are preferred in learning but it should be balanced between attitudes (affective) and skills (psychomotor) as well as the components of the study itself. Therefore, teachers in implementing the learning physics not only focus on the students learning of physics concepts, principles, and formulas, but also pay attention on students' development in physical skills and scientific attitudes.

Scientific attitude is one form of intelligence possessed by each individual. The scientific attitude of students in learning can affect the students learning outcomes [3]. In this paper, students developed some scientific attitudes such as: responsibility, curiosity, critical thinking, honesty and cooperative during the learning process. Those various attitudes were chosen based on interviews with the science teacher in the school where the research took place. It was found that the students in a state middle school in Ambon often did not work and follow the orders of the teacher. They were also hard to concentrate in during the learning process. Both of these conditions showed that the students were lack of responsibility. Besides those conditions that mentioned above, those students did not show enthusiastically which can be interpreted as low curiosity. In the class, students always only read from their book in answering questions and not try to build their own understanding based on what is read. This was indication of lack of critical thinking. Moreover, when they were given a task by the teacher in the class, students often cheat others which indicates dishonesty, and when they were working in a group, only a small fraction of students work together (less cooperation). The situations explained above were the reasons why this research should be carried out.

The objectives of this research were: (1) to identify which scientific attitude were formed when students were learning through using scientific approach; (2) to know students' achievement on physics if they were taught using a scientific approach; (3) to know the effectiveness of using the scientific approach in the learning process.

THEORETICAL BACKGROUND

To develop scientific attitudes can be conducted by role playing method. Using this method, the development of scientific attitude may be accomplished by focusing the students' learning to specific objectives through a series of persuasive communications oriented toward the cognitive domain of the individual attitude [4]. The other way is by treating students as young scientists in science class [5]. The involvement of students, both physically and mentally in class and laboratory activities will give an impact on the formation of the pattern of students' scientific actions. Therefore, the choice of methods, approaches, and learning models that are used in the classroom will have an important effect on students. One approach that is suitable to grow scientific attitude of the students in learning physics is scientific approach since this approach is closely related to the scientific method. A scientific approach can be accomplished in discovery learning [6]. Discovery learning is a learning model that integrates the elements of scientific approach. It is cleared in the syntax of this learning model, students are trained to observe, ask, try, reason, and communicate. There are five stages in the discovery learning syntax which follows: (1) stimulation, students are asked to observe and raise questions; (2) problem statement, students are asked to ask questions and gather information, (3) data collection, in this stage students are trained to observe, (4) data processing, students are encouraged to reason and ask, and (5) verification, this is the final stage where students are encouraged to reason and communicate. These stages showed that the discovery learning model is fit to the scientific approach. Using this learning model in physics classrooms, students will be required to find the concept through investigation and teachers will guide them to find and build the physics concepts through the processes of science. Through such kind of activities, students will be more actively involved in the learning process. It will also encourage and foster scientific attitudes and improve learning outcomes of the students.

1. Scientific Attitude

The issue about scientific attitude have been discussed from a long time ago. A scientific attitude is defined as a unified state of mind and it covers many characteristics. This attitude will tend to foster scientific achievement [7]. Attitude can also be understood as an internal ability that plays a role in the selection of action [8]. The chosen action depends on someone's attitudes to the assessment of the advantage or detriment, good or bad, satisfactory or not of the action. Thus, it can be said that attitude is a promote action for students to learn.

Attitudes are formed through variety ways, among others: (1) frequently experience, or experience with deep feeling; (2) imitation, which can be done accidentally or deliberate; (3) suggestion, an influence that comes from someone or something that has authority in someone's view; (4) identification, impersonate another person or an organization/specific material based on an emotional attachment, it usually occurs between students and teachers. There are several methods to change attitudes, they are as follows: (1) by changing the cognitive component of the attitude. This way provides new information about the object of attitude, so that the cognitive components becomes widespread; (2) by direct contact with the object of attitude. In this way the affective component also should be stimulated; (3) by forcing people to show new behavior which is not consistent with the attitudes that already exist [9].

Some research showed that attitude has become one of the factors that influence learning outcomes. On the contrary, students' environment can influence their attitude and achievement [10]. In science learning, attitudes are often associated with attitudes toward science (scientific attitude). Both are interrelated and both affect deed. Scientific attitude is a fervid conviction that problems within the range of science can only success fully solved by the scientific method of thinking [11]. A person who has scientific attitude shows: (1) willingness to change of opinion on the basis of evidence, (2) curiosity to search the whole truth regardless of personal religious or social prejudice, (3) having a concept of cause and effect relationship, (4) habit of basing judgment on fact, and (5) distinguish between fact and theory [12]. To form a scientific attitude of students, a teacher can do one or more of three types of roles: (1) giving an example, (2) providing reinforcement with praise and approval, and (3) providing an opportunity to develop an attitude. This means that before forming a scientific attitude in his/her students, a teacher must have the scientific attitude himself/herself first, so that they can provide an example to the students as a first step in the formation of the scientific attitude of his/her students [5]

Some experts grouped the scientific attitudes varies. However, the grouping is almost having no significant difference. The variations arise only in the placement and naming of scientific attitude highlighted. A test on scientific attitude had been developed long time ago, and it covered five attitudes such as: (1) conviction of universal basic cause and effect relations, (2) sensitive curiosity concerning reasons for happening, (3) habit of delayed response, holding views tentatively for suitable reflection, (4) habit of weighing evidence with respect to its pertinence, soundness and adequacy, and (5) respect for another's point of view, and open mindedness and willingness to be convinced by evidence. The measurement of students' scientific attitude was categorized into five degrees. The test had been correlated to aptitude test, scientific aptitude and the American Council Psychological tests. However, the correlation was not significant. Hence, it was concluded that a pupil receiving high average school grades will not necessarily acquire a high score on the scientific attitude test [13]. Similar result had been found in high school chemistry class. The correlation index was low which indicated that students may learn information but fail to get the desirable attitude that are potentially available in the same knowledge. There were some others research about scientific attitude: on curiosity aspect [14]; of science educators [15]; and on sensitive curiosity [16].

Those five attitudes had been developed into seven kind of scientific attitudes, those are: (1) curiosity; (2) critical thinking; (3) openness; (4) objectivity; (5) appreciating toward the work of others; (6) courage to defend the truth; and (7) imminence, the attitude of reaching out to the front. Here are some indicators of each dimension to measure students' scientific attitude [17, 18] which are: (1) curiosity: enthusiastic in searching answers, pay attention to the object that being observed, enthusiastic in the process of science, asks in every step of activities; In the research on sensitive curiosity that mentioned above, it was developed some indicators in measuring students' curiosity: careful and accurate observation or equally careful use of data collected by others, patient collecting of data, and persistence in the search for an adequate explanation. (2) supple: the participation of students in doing practical work and discussions, student attitudes in working with a group of friends, the attitudes of students in studying and applying the information in conducting experiments and discussions; (3) critical thinking: doubtful of friend's findings, ask any changes / new things, repeating what others do, and do not ignore the data though small. To develop the four indicators in critical thinking, Harlen formulated some aspects that can be assessed, namely: (a) ask the purpose of

the conducted experiment; (b) ask the tools and materials that are being used; (c) record the results of the observations; (d) tried to repeat the experiment; (e) questioned the observations of others; (f) report the results of the observations; (g) test again when the result is different; (4) honesty: the student not manipulating data, actual data recorded in accordance with the results of that group, did not cheat the results of other groups; (5) open-minded and cooperative: respect the opinion / findings of others, want to change the opinion if data is lacking, receive advice from others, do not feel always true, consider every conclusion is tentative, actively participate in group; (6) cautious: students choose the right tool when conducting experiments, students can use the tool properly, students observe the image correctly, students undertake steps to correct experiment, students can answer the group worksheet correctly; (7) environmentally sensitive: pay attention to events around, participation in social activities, maintain the cleanliness of the school.

2. The Scientific Approach

The scientific approach was first introduced in science education in America in the late of 19th century as an emphasis on laboratory methods formalistic that lead to scientific facts [19, 20]. The scientific approach is closely related to the scientific method [6]. Scientific method generally involves observation activities needed to formulate a hypothesis or collect data. The scientific method is generally based on the data exposure that obtained through observation or experiment. The scientific approach is intended to provide insights to students in recognizing, understanding the various materials using a scientific approach, that information can come from anywhere, at any time, and they should not rely on the information in the direction of a teacher. Therefore, it is expected to create learning conditions that will encourage the learners in finding out solutions from a variety of sources through observation, and not just be told [21].

Stages of Learning Using Scientific Approach

The main activity of the students in learning the scientific method is the main characteristic of scientific learning. In general, there are 5 aspects in scientific study to establish innovative skills, that is: (1) making observation; (2) asking; (3) conducting experiments; 4) making associations (connect / reasoning); and 5) developing networks [6]. Based on the Dyne theory, one can develop a scientific approach in learning that has components such as: (1) Observation. This activity uses the senses to obtain information that is intended to connect the subject matter with real contexts encountered in daily life by the problems or phenomena. Teachers should facilitate students to make observations with the media that presents a real object and train them using the five senses. The competence of the observation processes are trained seriously, thoroughness and find information [21]; (2) Ask Questions. Students need to be trained to formulate questions related to the topics. Learning activities are very important to increase the curiosity of the students and develop their skills throughout life. The question posed to escort students to conduct a more thorough observation. The question of the conditions or natural phenomena or social phenomena needs to be developed in the learning process so that students have the curiosity and interest to learn independently. Questions can also be submitted by students during or after studying a concept in relation to the application of the concepts. The competencies expected of this activity are to develop creativity, curiosity, the ability to formulate questions to establish critical thinking skills and a willingness to learn throughout life; (3) Doing Experiment / Getting Information. Learning to use a scientific approach will involve students in activities to investigate the phenomenon in an attempt to answer the problem. One that can be done is by doing an experiment. This activity can enhance and strengthen the students' curiosity and understanding of concepts and principles / procedures to collect data, develop creativity and skills of scientific work. These activities include planning, designing, and conducting experiments, and acquire, serve, and process data. The competencies expected to develop rigorous attitude, honest, polite, respect the opinions of others, the ability to communicate, implement the ability to gather information through a variety of ways to learn, develop the habit of lifelong learning; (4) Associate / Tuning. The ability to process information through reasoning and rational thinking is important competencies that must be owned by the students. The information obtained from observation or experiment must be processed to find a linkage with other information, to find patterns of linkage information, and to take the conclusions of the patterns found. Efforts to train students in reasoning can be done by asking them to analyze the data that has been collected so that they can find relationships between variables, or can explain the data based on the existing theory, testing hypotheses have been proposed, and make conclusions. The results of activities to try and associate enable students to think critically high level (higher order skills thingking) to think metacognitive [21]; (5) establish a network. Communicate needs to be owned by the

students for this competence is as important as the knowledge, skills and experience. Communicating activity is a means to deliver results in the form of verbal conceptualization, writing, drawings / sketches, charts, or graphs. This activity is done so that students are able to communicate knowledge, skill and application, as well as the creations of students through presentations, reports, and / or performance of the work. The competencies expected of this activity is to develop the attitude of honest, conscientious, tolerance, the ability to think systematically, express opinions brief and clear, and develop language skills are good and right [21].

3. Theories of Learning that Relevant to Scientific Approach

There are some theoretical backgrounds that relevance to scientific approach. The first theory is from Bruner. He marked the human cognitive development in as follows: (a) human intellectual development characterized by the progress in response to a stimulus; (b) the increasing of knowledge depends on the development of the information storage system realistically; (c) the intellectual development includes development of the talking ability to talk to oneself or to others through words or symbols of what has been done and what will be done; (d) systematically interaction between counsellors, teachers, or parents with children is necessary for cognitive development; (e) language is the key to cognitive development, for language is a tool of communication between people. Language is required to understand a concepts; (f) Cognitive development is characterized by an ability to propose some alternatives simultaneously, choose the appropriate action, can provide the proper precautions, and can give priority sequence in a variety of situations [22]. Bruner also emphasized the influence of culture on behaviour. In theory, the so-called free discovery learning, he said that the learning process will go well and creative if the teacher gives students the opportunity to define a concept, theory, rules, or understanding through the examples he encountered in his life. Therefore, the theory of Bruner supports with the scientific approach because it requires students to build and his/her own knowledge through science process as learning experiences.

The second theory is the Learning Theory of Piaget. According to Piaget, cognitive development is a genetic process, a process that is based on the biological mechanisms of the development of the nerve system. Every individual, from his/her born to adolescence grows through four levels of cognitive development and makes adaptation. The process of adaptation can be done in two ways: assimilation and accommodation. Assimilation is the cognitive process by integrating stimuli of perception, concept, law, principle or new experience into existing schemes in mind. Accommodation is the formation of a new scheme by modifying the existing scheme to match the characteristics of the existing stimulus. In learning, it is needed a balancing or equilibration between assimilation and accommodation. This learning theory is in agreement with the scientific approach [22].

The last theory is the learning theory of Lev Vygotsky. The theory was proposed to accommodate a socio cultural revolution in teaching and learning [22]. In his theory, Vygotsky stated that learning occurs when learners work or learn to handle tasks that have not been studied yet. However, those tasks are still within the range of ability or tasks that are in the zone of proximal development. The area lies between the levels of child development. Currently, no it has been practiced as problem solving skills development under the guidance of adults or peers who are more capable [23].

4. Learning Model that Compatible with Scientific Approach

Models, strategies, or methods of learning that appropriate to scientific approach can be seen based on the elements that are contained with scientific approach in it. It means the students should be involved in learning activities such as observing, asking, gathering information, reasoning / associating and communicating. The learning methods which are corresponding to the scientific approach are: learning-based inquiry, discovery learning, problem-based learning, and project-based learning. In this research, discovery learning had been chosen to be implemented [6].

Discovery learning model is used to understand the concept, meaning, and relationships, through an intuitive process to finally come to a conclusion. Discovery occurs when an individual is involved, especially in the use of mental processes to find some concepts and principles [21]. While using this learning model, a teacher acts as a mentor by providing opportunities for his/her students to learn actively, guiding and directing the students during the learning activities. Teachers should also have to give the opportunity to their students to become a problem solver, a scientist, a historian, or a mathematician. In other words, there should be a changing in the teaching and learning activities to be student oriented. In the discovery learning method of teaching materials is not presented in its final form. Students are required to undertake various activities to gather information, compare, categorize, analyze,

integrate, reorganize the material and make conclusions. So, with these situations, students are allowed to find the meaning by themselves, and are allowed to learn the concepts in enhancing their knowledge and skills. Thus, a teacher in applying discovery learning should be able to give students the opportunities more independent in learning.

Bruner said that the learning process will go well and creative if the teacher gives students the chance to find a concept, theory, rules, or understanding through the examples he encountered in life. Here are the steps in applying the model of discovery learning in a classroom: (1) Stimulation. At this stage, students are exposed to something that causes confusion, so that the desire to investigate is arise. Besides, teachers can start the learning activities by asking questions, suggesting read books, and other learning activities that lead to the problem solving. Stimulation at this stage provides the conditions of learning interaction that can develop and assist students to explore materials. By questioning students are encouraged to do exploration. Thus, a teacher must be a master in techniques of giving a stimulus to the students so that the goal to make students have curiosity to explore can be achieved; (2) Problem Statement. The second step is the teacher allowing students to identify as much as possible the problems that relevant to learning materials. One of them is selected and formulated in hypothetical form (temporary answer to the question of the problem). Giving students the opportunity to identify and analyze the problem is a useful technique in building students so that they are accustomed to find a problem; (3) Data Collection. In this step, a teacher provides an opportunity for students to gather as much information relevant to prove whether or not the hypothesis. This stage serves to answer questions or to prove the truth of the hypothesis. Several activities can be done in this stage, such as: collecting data of various relevant information, reading literatures, observing objects, interviewing with informants, conducting their own trials and so on. The importance of this stage is the students learn actively to find something related to the problems, thus it inadvertently connects the students with their prior knowledge with the problem; (4) Data Processing. Data processing is an activity to process the data and information that had been obtained by students through interviews, observation, and so on, and then interpreted. All those information from readings, interviews, observations, and so on all processed, randomized, classified, tabulated, even it is calculated and interpreted in a certain way at a certain confidence level. Data processing is also called the encoding / categorization which serve as the formation of concepts and generalizations. In generalization, students will gain new knowledge about alternative answers / settlement that needs proof logically; (5) Verification. At this stage, the students perform a careful examination to verify whether or not the hypothesis set out earlier by the alternative findings. They will connect the hypothesis with the results of data processing. Verification according to Bruner, aims to make the learning process will go well and creative if the teacher gives students the chance to find a concept, theory, rules or understanding of the examples they encountered in their life. Based on the results of processing and interpretation, or information, statements or hypotheses that have been formulated earlier was then checked, whether answered or not, whether proven or not; (6) Generalization. Phase generalization is draw a conclusion that the process can be used as a general principle and applies to all events or the same problem, taking into account the results of the verification. Based on the results of verification the principles that underlie generalizations then formulated. After concluding the student must pay attention to the process of generalization that emphasizes the importance of mastering a lesson on the meaning and rules or principles underlying the broad experience of a person, as well as the importance of the regulatory process and generalization of these experiences [21].

METHOD

The research was carried out using descriptive type. In this study, the situation described was the scientific attitude and learning outcomes of students at grade 7 in a middle school in Ambon. The research design is one group pre-test – post-test design. The sample was chosen purposively by the consideration on previous interviews with the physics teachers of the school. The class sample has the lowest average score in physics. It is assumed that if the treatment was succeeded at the lower level of students, it will be succeed at the upper level. The numbers of the students in the class were 18 students.

Some instruments used in this research were: test items, students' worksheet, and observation sheets. The test and students' worksheet instruments covered the Heat material and had been verified by 5 lecturers of Physics Education Program in a university at Ambon. The test instrument consisted of 20 multiple choice items, and 5 problem solving.

The students' worksheets were used to assess students' cognitive aspect during the learning process while the observation sheets were used to measure students' affective and psychomotor aspects, and their scientific attitudes respectively. Affective learning outcomes refer to the attitudes and values. The scoring of this aspect was based on

the values and attitudes that were expected to appear in the learning process by using discovery learning model since the objective of assessment was not the knowledge alone [24]. There were four indicators measured in the affective aspect. Those were: admiring the greatness of God, providing information, discipline, and respect for others' the opinion. The assessment on the admiration the greatness of God was based on indicators of students' relationships with the Creator through prayer, and the information and technical indicators provided information the way students in learning. The discipline was assessed based on the indicators of punctuality to come to class and turning in assignments, not bothering friends while the teacher is giving explanations at any learning processes. The scoring of respecting the opinion of friends based on the indicator: giving friends opportunity to say their opinion, not cutting the opinion of friends, receive and respond to the opinion of friends as well. The psychomotor aspect had been measured using five indicators: using tools, raising questions, answering questions, presenting results, and making conclusion.

The assessment of students' scientific attitudes covered: responsibility, curiosity, critical thinking, honesty, and cooperative during the learning process. As on indicators developed in this posture assessment, students are trained to take their own equipment lab, maintaining the integrity of laboratory equipment, as well as cleaning and restoring these tools after completed the experiment. In measuring the students' curiosity in this study, it had been developed several indicators, namely: ask the experimental procedure, enthusiastically looking for answers, attention on the object being observed, and repeating the conducted experiments. The indicators of critical thinking developed in this study were: asking the use of tools and materials, taking note the results of observations, questioning the results of the experiment / answer of other friends logically, and to submit the lack of the work of other groups. The honesty of the students was measured by using some indicators below: not doing plagiarism, repeating measurements in data collection activities, not manipulating data, and delivering their group result. The last attitude was cooperative. This attitude had been measured with indicators such as: active participation in the group, do brainstorm with friends to solve problems, help friends who are having difficulty, and helping each other in doing experiment.

The data gathered had been analyzed descriptively and placed in an interval scale and categorized qualitatively using the Minister of Education in middle schools standards while the effectiveness of the learning process using scientific approach was analyzed using the formula:

$$t = \frac{M_d}{\sqrt{\frac{\sum(x_d)^2}{N\,(N-1)}}} \tag{1}$$

where Md is the mean of deviation (d) between the final and the initial test; $\sum(x_d)^2$: the sum of squared deviations and N is the numbers of students. The t-test criteria are: if $t \geq t_{table}$, then the learning model used is said effective and if $t < t_{table}$, it is ineffective [25].

RESULT AND DISCUSSION

1. The Students' Results on Pre and Post Test

The students' achievements in the pre and post test are shown in Table 1, as follows:

Table 1. The Students Qualifications in Pre and Post Test

Mastery Level	Pre Test		Post Test		Qualification
	Frequency	Percentage (%)	Frequency	Percentage (%)	
86 – 100	-	-	6	33	Very good
71 – 85	-	-	10	56	Good
56 – 70	-	-	2	11	Adequate
< 56	18	100	-	0	Fail

Table 1 shows the mastery level of the students before and after learning the Heat material. It is cleared to see that 100% of the students were fail at the pre test. Their average score was 24.4 which too low. The post test on the contrary, all the students scores were spread from adequate to very good qualification, and the average score was 80.8. After following the learning process using a scientific approach, it is shown that there were 6 students or 33% of them able to master the learning indicators in excellent qualifications, 10 of them or 56% were in good qualification, and 2 students (11%) were adequate.

The prior knowledge of the students had been determined by the pre test results. A pre test aims to determine which material has or has not been mastered by the students [26]. The pre test results of the students in grade 7 showed that all of them had not understood and mastered the topics in Heat material. The scores of the students were still far below from the desired criteria. It can be inferred that their knowledge about Heat was more based on their experience in daily life. They still had difficulty to understand the new knowledge that was not connected to what they had known. This situation has been mentioned by Trianto (2007) that a student will have difficulty in understanding a specific knowledge, which is not connected with his/her prior knowledge. Students' knowledge of the Heat topic must be more expanded and deepened. Based on the results, all the indicators developed in this study should be taught, although some students could answer correctly some questions [27].

The function of the formative test or post-test is to determine the level of student mastery of the competencies that have been determined, either individually or in groups [28]. Formative tests aim to obtain the information required by an evaluator of the students in order to determine the level of development of students in the learning process [29]. In this research, the formative test was to determine students' understanding of the Heat material. Referring to the passed or not passed qualification at that school, which is 71, there were still 2 students or 11% had not passed the formative tests although they were in the adequate qualification. This condition was because students could not solve problems about the effect of heat on the phase transition, calculating the amount of heat required to change the temperature of the object, and calculating the amount of heat required to change the states of matter. However, the average of formative tests classically obtained was 80.8. It indicates that all the students already have knowledge and understanding of the Heat material that had taught using scientific approach (model discovery learning).

2. Learning Process Assessment

During the class sessions, the students worked in groups. Table 2 shows the average score of students' results in during the learning process.

Table 2. The Students Qualifications in During the Learning Process

Mastery Level	Cognitive Aspect		Affective Aspect		Psychomotor Aspect		Qualification
	Frequency	Percentage (%)	Frequency	Percentage (%)	Frequency	Percentage (%)	
86 – 100	8	44	17	94	12	67	Very good
71 – 85	10	56	1	6	6	33	Good
56 – 70	-	-	-	-	-	-	Adequate
< 56	-	-	-	-	-	-	Fail

The cognitive learning refers to the learning outcomes pertaining to the development of the brain and reasoning abilities of students or the ability to think [30]. The 18 students (100%) declared individually complete with different categories, 8 of them or 44% with a very good category, and 10 (56%) in good category. The average of student achievement scores on cognitive aspects was 86.2 which very good category. It is obvious to see that the students were able to work and find the concept of Heat with the help of worksheets. The students' worksheet in this study was developed based on discovery learning, making students learn actively to find their own knowledge through the stages of discovery learning models.

Based on the results of the study, the 18 students or 100% were success. There were 17 (94%) students at very good category and 1 (6%) of students at good category. The average score of the students in the affective aspect is 94 which very good category. This proves that the student learning experiences in this study were succeeded in making students have positive attitude.

The psychomotor aspect refers to the ability of someone to act that covers all behavior using nerve [30]. In the process of learning, 12 (67%) of students were very good and 6 (33%) students in good category. The average score of the students' achievement was 87.5 or in very good category.

The learning process had been assessed in this research. The assessment covered 3 aspects which are: cognitive, affective, and psychomotor aspects respectively. It was possible to assess these aspects since the stages of discovery learning models such as stimulation, problem statement, the data collection, the data processing, verification and generalization were developed in the students' worksheet and in the learning scenario. At the stage of stimulation, the students were confronted by a problem that had been created by the teacher. The problem was related to the

achievement indicators of the learning, so that the students could focus their mind directly and find the answer to the problem based on their experiences through the available learning resources. Furthermore, at this stage, the students were directed to make hypothesis based on the findings. Then, students were encouraged to do activities to prove their hypothesis through the stages of data collection, the data processing, verification and generalization. Therefore, the discovery learning model is very good to establish and improve the cognitive abilities of students. It emphasized students learning by being active in finding and constructing their own concepts. This situation confirms what is said that based on fact and observation, the students had positive attitude towards experiments and helped them to improve and enhance their skills and cognitive processes [10]. The affective aspect supported the cognitive skills of the students as it was said by that the affective component will determine the success of learners. This research showed an indirect evident about that connection [32].

In this research, the discovery learning model provided vast opportunities to students to become creative in the classroom. Students had the opportunity to develop their psychomotor skills to become optimum in mastering the Heat concept. This situation is consistent with the constructivism learning theory which states that knowledge is constructed in the mind of the student. In this case, the students tried to find meanings and connection sequence of the events from the information they had based on their experience. skills are also more emphasis on the process of growing and developing a number of specific skills in self-learners so that they are able to process information so discovered new things and useful in the form of facts, concepts, and the development of attitudes and values. Therefore, the success of students in the psychomotor aspects is because students have received experience specific learning through the constituent components of psychomotor aspects, namely experimenting process, presenting the results of the discussion, practicing materials that require examples of real learning, and all aspects of that have been summarized in the stages of discovery learning models [33].

3. Scientific Attitudes

The Table 3 below shows that all of the 18 students had high scores in scientific attitudes. The highest score was the responsibility attitude, which 100% of the sample had excellent qualifications. The lowest average score of the students was in curiosity with average of 84.7. The data had been spread out as: 11 students (61%) were in excellent qualifications, 4 (22%) of them were good, 2 of them (11%) were adequate, and 1 student (6%) was at fail category. The data of students' critical thinking were dispersed as: 12 students or 67% were in excellent qualifications, 5 students or 27% were good category, and 1 student or 6% of the students were in low category with average of 86.1. It was excellent, although there was one student or 6% was in the less qualification. This result above is also showed that the critical thinking of the students can be formed and need to be improved. The honesty attitude distributed as: 17 (94%) of students were in very good qualification, and 1 (6%) students was in good qualification. The average of the honesty scores was 95.8 which excellent. The average attitude of students' cooperation scores was 93.7 and the scores were grouped as: 16 (89%) of students were in a very good qualification, and 2 (11%) students were on a good qualification.

Tabel 3. Students' Scientific Attitudes

Type of Scientific Attitude	Average Score
Responsibility	100
Curiosity	84.7
Critical Thinking	86.1
Honesty	95.8
Cooperation	93.7

The scientific attitudes in this research covered: responsibility, curiosity, critical thinking, honesty, and cooperative. The responsibility attitude can be formed on students during the learning process. The learning environments were conditioned to make students have this attitude. The learning environment conditions were formed naturally by the stages in the discovery model of learning. Starting from the stage of stimulation, problem statement, data collection, data processing, verification, until generalization, students were required to have a responsible attitude by getting involved directly and actively participate in the work and group discussion. Active participation can only happen if students view it as important and have a sense of responsibility in collecting data through practicing. The process in this study had directly trained students to have a responsible attitude. Based on

the observation, each student in his/her group helped each other to carry out all of the indicators without exception. Students also showed a responsible attitude of students is to restore the worksheets in the teacher after the entire process is completed.

The curiosity can be fostered in discovery learning model since this aspect appeared in the syntax. Starting from stimulation phase, students were confronted to the problems of the topics. They were pushed to arise question and needed to know more. In the problem statement stage, students would feel curious about the truth of their hypothesis. Later in the syntax of data collection, the students' enthusiastic had been challenged, and they needed to carry out some activities during the experiments. Similarly, it was happened in the syntax of data processing, verification, and generalization. From the data above, there is one (6%) of students in less qualified, because it has an average score of achievement of less than 55 which is 50. However, it does not mean that the student does not have an attitude of curiosity in him, but the attitude it has grown because he has done two indicators of attitude of curiosity there, just have to need to be sharpened again to get maximum results. It can be concluded that the attitude of curiosity has been formed on each student's self

The discovery learning model can promote students' critical thinking attitude since the syntax in the discovery learning model gives students the opportunity for the formation of this attitude. At the stage of identification and formulation of hypotheses, the students' critical attitude arose from some provisional answers and opinions incurred. From some variation, it was expected that students can think critically to determine the answer that most closely. The critical thinking attitude also emerged for their opinions, ideas, feedbacks or criticisms that occur during a discussion in the stage of processing and interpretation of data and the verification phase. Critical thinking attitude toward the findings generated is also derived from activities in the stage of collecting data. The achievements of the students in critical thinking attitudes also influence student learning outcomes. It has been proven that students with lack critical thinking got lower achievement. Therefore, the critical thinking of the students must be developed to optimize the abilities of students in cognitive, affective, and psychomotor aspects.

Honesty is an attitude that can be developed in the implementation of discovery learning model. In this model of learning, fairness can be seen in the syntaxes, especially in the syntax of data collection. Students are required to record all the data or information obtained from the experiment in order to find the concepts expected. The results of conducting these activities will form the students' honesty. This attitude will also appear after the students completed experiments since they are expected to write down the results according to what has obtained in the experiment. This is in accordance with the indicators developed in this study to measure the honesty of the students [19]. The honesty that has been formed it will be benefit for students in their life. Therefore, this attitude should be growth and developed in learning sessions so that they will become great successors in the future.

Based on the indicators used to measure the cooperative attitude, it can be seen that the students had achieved some indicators in very good qualification. The excellent qualifications achieved by students due to the learning implementation in the discovery learning models that can make students able to cooperate with friends in the learning phases. Each stage experienced by students, from stimulation until generalization required cooperation from every individual to perform activities within the group. For example, at the stage of data collection, students were given the opportunity to conduct experiments. Experiments trained cooperation among students in the group. Here, students had to put aside their egoism and had been trained to be cooperative.

4. Effectiveness Test (t-test)

The effectiveness of using a scientific approach (model discovery learning) can be known through the calculation of t-test. It had been found that the t value was 35.95. Since t is more than t_{tabel} which 2.101 at 5% significance level, it can be said that there is a difference between prior knowledge of the students and their knowledge after the treatment. It means the treatment was effective toward the students' achievement in the test.

Test effectiveness of a learning model can be determined by the "t" test forIn general, the two variables were compared to determine the effectiveness of a learning model toward the learning process using the pre test and post test results. Based on the t-test calculation of this study, it can be concluded that there is a significant difference between the initial test and formative test. Thus, the implementation of the learning process using a scientific approach can be said to be effective in achieving the learning outcomes of the students at seventh grade in Heat material. The average difference in student achievement scores on the test early and formative tests also proved it. The comparison between prior knowledge of students and their final ability is very much different. In preliminary tests, 100% of students could not achieve a good score, but at the end of the test almost all students got a good score. This result shows that the teacher had been successfully managing the classroom in the learning process using a

learning model that can help students to achieve better learning outcomes. These findings are in line with the opinion of who said that the efficiency and effectiveness of teaching in good interaction learning process is all the resources and efforts of teachers to provide learning environment for students to learn well [28].

CONCLUSION

The results of this research represent a condition of the students at grade 7 in a middle school in Ambon before and after learning using a scientific approach. The result showed that students can achieve very good learning outcomes. The learning process also could be environmentally setting to accommodate the growing of positive attitudes of the students. The scientific attitudes that can be grown and developed in this research are responsibility, curiosity, critical thinking, honesty and cooperative. Besides it can grow and develop the scientific attitudes of the students, the using of this approach can help students to have good achievements in three aspects, cognitive, affective and psychomotor as well. This is in line with the note of psychological study, that learning can change the behavior as a result of an interaction with the environment that meeting the needs of the students [9].

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