Guided inquiry model based on scientific approach to science learning of the students of SMPK Stella Maris Biudukfoho

Y F Tabun¹*, W Sunarno², Sukarmin²

¹Science Education, Postgraduate Program, Universitas Sebelas Maret
Jl. Ir. Sutami 36A Kentingan Jebres, Surakarta 57126, Indonesia
²²²Physics Education, Postgraduate Program, Universitas Sebelas Maret
Jl. Ir. Sutami 36A Kentingan Jebres, Surakarta 57126, Indonesia

*yohanatabun96@student.uns.ac.id

Abstract. This study aimed to determine the science learning outcomes of students in the aspect of cognitive, affective and psychomotor using a guided inquiry model based on a scientific approach. This study is quasi-experiment with nonequivalent control group design. The population is the whole students of Stella Maris Biudukfoho Chatolic Junior High School (SMPK) at grade eight in the Academic Year of 2018/2019. The sample consists of two classes taken by cluster random sampling technique, namely class VIII A as the experimental class and class VIII B as the control class. Data collecting tools namely tests, questionnaires and observation sheets were used in this study. Data analysis of students’ learning outcomes were done using Independent Samples t-test. The results of the three aspects of learning outcomes namely aspects of knowledge, attitudes and skills indicated that the p-value < 0.05 so that H₀ is rejected and Hₐ is accepted. Thus, there were differences in learning outcomes of students who were given learning method using guided inquiry with students using who were given conventional learning. However, the results from data analysis, p-value of knowledge aspect is 0.000, p-value of attitudes aspect is 0.043 and p-value of skills aspects is 0.001.

1. Introduction

The curriculum is the basis of organizing learning activities that regulate goals, contents, and learning materials for achieving certain educational goals (The regulation of Education and Culture Minister Number 59 of 2014). Based on the definition, there are two dimensions that must be adjusted in implementing the 2013 curriculum, namely (1) plans, arrangements regarding goals, content and learning materials; and (2) the methods of learning activities [1].

The objective of learning according to the 2013 curriculum is student-centered learning. However, the implementation of the 2013 curriculum has not been fully implemented in accordance with its objective. There are many teachers in schools applying the lecture method interspersed by questions and answers session, or it can be called as teacher-centered learning. The lecture method makes students not actively participate in learning. Besides that, the lecture method makes students unable to understand the concept of science [2].

Based on the results of observation and interview at Stella Maris Biudukfoho Chatolic Junior High School (SMPK) in the odd semester in the academic year of 2018/2019, the learning process is still not effective because the students can't understand the teachers' explanation. As a result, they tend to be a passive learner. In class, teachers often use the lecture method in conveying the concept of science. The use of the lecture method places students as listeners and note takers. It makes students have limited ability at a low level. The disadvantage of the lecture method is the students only master the materials given by the teacher, whereas the teachers find difficulty in ensuring students’ understanding [3]. If the teacher has poor speaking skills, the lecture method will be very boring. Based on the description above, the students get knowledge in minimum portion. It is strengthened by the results of daily tests on the material of vibration, wave, and sound in the previous Academic Year, namely 2017/2018 with an
average value of 67, where the value is below the standard of minimum completeness (KKM). In addition, there are no appropriate learning media. According to the problems, innovation is needed in applying learning models that are in accordance with the objective of the 2013 curriculum. In addition, the learning model should appropriate with the characteristics of the students and the materials. The appropriate learning model of Science learning is Guided Inquiry [4].

1.1 Guided inquiry
Guided inquiry is one of the learning models to teach concepts and relationships between concepts. When using this learning model, the teacher presents examples to students, guides them, and provides a closing statement when they can describe the ideas taught by the teacher [5]. In this learning model, teachers must have the skill to provide guidance, namely to diagnose students' difficulties and provide assistance in solving problems [6].

The syntax of learning used in this study adapted from the syntax of inquiry learning proposed by Trianto (2010)[7]. The syntax of inquiry learning are as follows:

| Syntax | Teachers’ Activity |
|--------|--------------------|
| Retrieving questions and problems | Teacher guides students to identify problems. Then, problems are written on the board whereas teacher divides students into groups. |
| Creating hypothesis | Teacher provides challenges and opportunities for students to discuss in creating hypotheses. Teacher guides students in determining hypotheses that are relevant to the problem and prioritizes which hypothesis is the priority of the investigation and experiment. |
| Planning and designing experiment or demonstration | Teacher provides opportunities for students to determine the steps in line with the hypothesis created. Teacher guides students to sort the experimental steps. |
| Conducting experiment or demonstration to get data | Teacher guides students to get data and information through experiments. |
| Collecting and analyzing data | Teacher gives an opportunity to each group to convey and present the results of analyzing the collected data. |
| Inferring the result | Teacher guides students in making conclusions based on the results. |

The main objective of the guided inquiry is to develop students’ independence in expanding their knowledge from various information sources which will be employed both inside and outside of school. The example of resources in schools, such as library materials, databases, and other selected sources that are equipped and developed by public libraries, local community resources, museums, and the internet [8]. Moreover, in making students actively involved in the learning, it not only employs the appropriate learning model but also applies the suitable learning approach [9]. An appropriate learning approach which is in line with the 2013 curriculum in the application of the guided inquiry learning model is the scientific approach [11].

1.2 Scientific approach
A scientific approach is an approach that adopts scientific steps in building knowledge through the scientific method. According to Alfred De Vito, the scientific approach allows the cultivation of
scientific thinking skills, the development of "sense of inquiry", and critical thinking skills [10]. This idea is in line with the opinion of the Minister of Education and Culture (2013) who said that the scientific approach is a learning process designed in such a way that students actively construct concepts, laws, or principles through the stages of identifying and formulating problems, submitting or formulating hypotheses, collecting data with various techniques, analyzing data, drawing conclusions and communicating concepts, laws, or principles [11].

The research results conducted by Wiwin, who state that the application of guided inquiry learning has a significant influence on the skills of basic science processes of eighth-grade students of State Junior High School (SMPN) 7 Surakarta [12]. In addition, a study conducted by Machin, states that the application of this approach has a positive effect on cognitive, affective, and psychomotor aspects and it also achieves the determined classical completeness, i.e more than 85% of the whole students who involve in the learning process [13]. This is because students make direct observations of the objects as the scientists do. Based on the description above, research entitled "Guided Inquiry Model Based on Scientific Approach to Science Learning of the Students of SMPK Stella Maris Biudukfoho" was conducted. The purpose of this study is to find out students’ learning outcomes of cognitive, affective, and psychomotor aspects using the application of the Guided Inquiry Model Based on the Scientific Approach.

2. Methods
The type of this study is a quasi-experimental research, in which the research design used is Non Equivalent Control Group Design. The population in this study were all VIII class of SMPK Stella Maris Biudukfoho. The study sample consisted of two classes namely class VIII A and class VIII B which were taken by cluster random sampling. Class VIII A was pointed as the experimental class with the treatment using the Guided Inquiry Model Based on Scientific Approach and class VIII B was pointed as the control class with the treatment using Direct Learning as a part of conventional learning. The instrument used in this study were syllabus, lesson plan and students’ worksheet. tools namely tests, questionnaires and observation sheets were used in this study. Data analysis technique were consisted of analysis prerequisite tests and hypothesis analysis tests. First, a prerequisite test analysis is carried out, including the normality test and homogeneity test. The normality test is used to determine the distribution of science learning outcomes data in the experimental and control classes by using Chi-Square analysis and homogeneity tests carried out to determine whether the variance of the experimental and control groups is homogeneous or equal. Hypothesis testing is carried out using Independent Samples t-test. Hypothesis testing is done to find out whether the alternative hypothesis that has been submitted is accepted or rejected.

3. Results and discussions
Data in this research include data on learning outcomes of cognitive, affective, and psychomotor aspects. The data are obtained from the results of tests, questionnaires, and observations of students of class VIII A and Class VIII B. Each class consists of 20 students. In this study, class VIII A as the experimental class and class VIII B as the control class. Based on the research that has been done in Stella Maris Biudukfoho Chatolik Junior High School (SMPK), the results were recorded in table 1.

To examine the hypothesis of learning outcomes data of cognitive aspect, affective, and psychomotor, the Independent Samples t-Test was employed. Hypothesis testing uses SPSS for Windows 16.0. Statistical tests are carried out at a significance level of 5%, so, if p-value less than 0.05, H0 is rejected, which means there are differences. So, if p-value greater than 0.05, then H0 is accepted which means there are no differences. A summary of the hypothesis test results can be seen in table 2.

Based on hypothesis testing, p-value of knowledge aspect is 0.000, p-value of attitudes aspect is 0.043 and p-value of skills aspects is 0.001. The results of the three aspects of learning outcomes namely aspects of knowledge, attitudes and skills indicated that the p-value less than 0.05 so that H0 is rejected and H1 is accepted. Based on this results, the Guided Inquiry Model Based on the Scientific Approach is obtained in improving learning outcomes in aspects of knowledge, attitudes and skills of
students in VIII grade on chapter vibration, wave and sound in SMPK Stella Maris during Academic Year of 2018/2019.

Table 2. Hypothesis test results of learning outcomes of cognitive, affective, and psychomotor.

| Hypothesis | Learning outcomes | p-value |
|------------|------------------|---------|
| 1          | Cognitive        | 0.000   |
| 2          | Affective        | 0.043   |
| 3          | Psychomotor      | 0.001   |

Based on table 2, it can be explained the hypothesis testing on the aspects of students’ cognitive, affective, and psychomotor towards the use of the Guided Inquiry Model Based on the Scientific Approach are the following conclusion below:

3.1 Students’ learning outcomes of cognitive aspect

Table 3 showed the average student learning outcomes aspects of knowledge in the experimental class are higher than the control class. The diversity can also be seen from the range of maximum and minimum values in the experimental class and the control class. This means that there is an increase in learning outcomes in the treated group in the form of the implementation of a Guided Inquiry Learning Model compared to the class treated with the direct learning model.

Table 3. Data description of learning outcomes of students’ cognitive aspect.

| Class       | The number of students | Mean  | Min | Max |
|-------------|------------------------|-------|-----|-----|
| Experiment  | 20                     | 70.25 | 60  | 80  |
| Control     | 20                     | 55.25 | 50  | 65  |

Table 4. Distribution of students’ value of cognitive aspect.

| Category   | Experiment Class | Control Class |
|------------|------------------|---------------|
|            | Responden | Percentage (%) | Responden | Percentage (%) |
| Very Good  | 0         | 0              | 0         | 0              |
| Good       | 17        | 85%            | 3         | 15%            |
| Medium     | 3         | 15%            | 17        | 85%            |
| Low        | 0         | 0              | 0         | 0              |
| Very Low   | 0         | 0              | 0         | 0              |
| The number of students | 20     | 100            | 20        | 100            |

Based on Table 4, in the control class, there are 15% of students who have good categories and 85% have medium categories. Meanwhile, in the experimental class, there are 85% of students having good categories and 15% of students having medium categories.

The students’ learning outcomes of the experimental class are higher than the control class in the knowledge aspect. It influenced by several factors. The experimental class considers that Guided Inquiry Model Based on the Scientific Approach is more interesting than direct instruction Model which is often applied by teachers. Another factor is the students’ involvement in the learning process. The Guided Inquiry Model Based on the Scientific Approach facilitates students to discover the concepts of
vibration, waves and sounds by observing a real environment. It is in line with the statement of Ristanto, et al (2010) that the real environment provides a very important stimulus for students in learning and exploring something new [14]. Finding something new is fun for students. Pleasant learning can increase students’ learning motivation because they do not feel bored in participating in the learning activities. Learning vibrations, waves, and sounds by presenting the object of study can directly provide learning experiences to students so that the material concepts will be easily understood by students. This is in agreement with Edgar Dale's statement in the classification of learning experiences which states that good learning is learning through direct experience. In the learning process, students not only observe, but also enjoy, be directly involved, and be responsible for the process and results [15].

Another factor is the coverage of the whole students’ learning styles can be accommodated through the use of the guided inquiry model based on a scientific approach. This is in line with [16], they view that the teachers must accommodate all students’ differences, such as habits, interests, and learning styles by selecting the appropriate learning approaches and teaching materials in order to achieve optimal learning outcomes. The suitable model and learning approach supported by a good learning style will create more meaningful learning.

In the control class, the learning model is Direct Instruction. In the process, the teacher conveys the material of vibration, wave, and sound without presenting the real object of study. This way has an impact on the results of the posttest value of the control class. They have a lower value than the experimental class. Based on the experience of Edgar Dale in [17], knowledge will be increasingly abstract if the message is only conveyed through verbal words. As a result, the students only understand knowledge in the form of words, without understanding the meaning contained in that knowledge. In the Direct Instruction model, students’ learning styles are not covered as a whole. Only the students with an audio and visual learning style can receive learning materials optimally. The experimental class students have higher learning activities compared to the control class students because of the direct involvement in the learning process. It can be seen from the learning syntax of the Guided Inquiry Model Based on the Scientific Approach starting from orientation to validation. Each syntax in the learning model has activities based on the Scientific Approach including observing, asking, gathering information, associating, and communicating.

In the first syntax of orientation, students begin to be directed to focus on the subject matter to be delivered by the teacher. At this stage, the teacher conveys the learning objectives so that students know the learning activities that will be carried out at that time, tries to explore students' initial understanding and motivates students.

In the second syntax of exploration, there is a scientific approach in the form of observing and asking questions. Observing activities is very useful for fulfilling the curiosity of students so that learning has a high meaning. At this stage, the teacher provides an opportunity for students to make observations on the object of study through the activities of seeing, listening, and paying attention to the important things of the object [18].

The third syntax is formation. In the syntax, there is a Scientific Approach in the form of collecting data. The activity of collecting data is employed to explore and collect information from various sources. Through the activity of collecting data, students learn carefully, honest, polite, and respect the opinions of others. Activities to collect data are carried out by observing the school environment. This is in accordance with the provisions of the Minister of Education and Culture Regulation Number 81 A of 2013 which states that in the activity of collecting data, students can carry out experiments, observations, read other sources such as textbooks, observe objects or events, activities, and interviews with informants to obtain information [19].

The fourth syntax is the application, there is associating activities. In this activity, students are required to analyze the results of observations in accordance with the material concepts of existing teaching materials and make conclusions on the obtained data. Associating activities aim to build the ability to think and to be scientific. The data obtained is made a classification, processed, and found specific relationships. The results of associating activities allow students high-level critical thinking (higher order thinking skills) to think metacognitive [20].
The fifth syntax is validation. In the syntax, there is an activity to communicate. The activity is carried out by presenting students’ learning outcomes in front of the class to the teacher and other friends. This activity is useful for developing the ability to think systematically, expressing opinions briefly and clearly, and developing good and correct language skills [21].

3.2 Students’ learning outcomes of affective aspect

Based on the data in table 5, the average student learning outcomes in the attitude aspect of the experimental class using guided inquiry learning models is higher than the control class using the direct learning model. This can also be seen in the maximum and minimum values of the experimental class and the control class.

| Class       | The number of students | Mean  | Min  | Max  |
|-------------|------------------------|-------|------|------|
| Experiment  | 20                     | 76.05 | 61   | 88   |
| Control     | 20                     | 71.55 | 61   | 80   |

Learning by using the Guided Inquiry Model Based on the Scientific Approach makes learning outcomes of the experimental class is higher than the control class in the aspect of affective. It is because the use of this learning model is conceptually active involving students. In this learning, students take part in teaching and learning activities according to the direction of the teacher, cooperate with the group during observation, and find out the facts and concepts through scientific steps appropriately. This is supported by the statement of [18] which states that students must be trained to solve problems based on facts through a scientific approach. It is different from the control class that uses Direct Instruction learning, where students are given less opportunity to be actively involved in learning. The students only have a chance to hear and record important things conveyed by the teacher. Brunner in [22] states that students should be allowed to look for and find out the meaning from everything they learned so that the students are expected to be able to understand the concept by their own language.

3.3 Students’ learning outcomes of psychomotor aspect

Table 6 shows the average student learning outcomes aspects of the skills in which the experimental class using guided inquiry learning models with a scientific approach is higher than the control class that uses the direct learning model. The maximum and minimum values of the experimental class are also higher than the control class.

| Class       | The number of students | Mean  | Min  | Max  |
|-------------|------------------------|-------|------|------|
| Experiment  | 20                     | 81.9  | 70   | 95   |
| Control     | 20                     | 75.25 | 65   | 85   |

The learning outcomes of students who were treated by using the Guided Inquiry Model Based on the Scientific Approach in the experimental class is higher than the control class. This matter shows that the students have the ability in collecting data through observing a phenomenon, processing and analyzing data as the conclusion, and communicating directly the results during the learning process through presentations in the class. These activities automatically optimize the use of senses, so that the students gain meaningful learning experiences. Each syntax in a Guided Inquiry Model Based on a Scientific Approach teaches the students about science process skills [23].
In contrast to the experimental class, the use of the Direct Instruction Model in the control class causes students’ activities are limited only by listening to teachers’ explanation, even though it is interspersed with discussion. However, the teacher still dominates learning so it does not involve the active role of the whole students [24]. In addition, the syntax in the Direct Instruction model of the control class does not train students’ science process skills optimally [23], so that it has an impact on the limited role of students in the class.

4. Conclusion
Learning process using the Guided Inquiry Model Based on the Scientific Approach shows that there are significant differences in the average learning outcomes of Science of Junior High School students in the aspect of cognitive, affective, and psychomotor. This matter happens because the guided inquiry learning model facilitates students to construct their own knowledge and actively engage in learning so that students’ learning outcomes are more meaningful. The Guided Inquiry Model Based on Scientific Approach also makes students able to recognize and apply scientific methods through detailed steps and work together. Thus, it can be concluded that science learning outcomes on aspects of knowledge, attitudes and skills are significantly better on average based on the application of Guided Inquiry Model Based on Scientific Approach compared to the application of direct learning models which was a part of conventional learning.

References
[1] Permendikbud 2014 Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 59 Tahun 2014 Tentang Kurikulum 2013 Sekolah Menengah Atas / Madrasah Aliyah (Jakarta: The Minister of Education and Culture of Indonesia)
[2] Hisyam Z, Bermawy M and Sekar A 2008 Strategi Pembelajaran Aktif (CTSD: Yogyakarta)
[3] Sanjaya, W 2006 Learning Strategy Jakarta: Kencana Prenada Media Group.
[4] Miftahul 2013 Model-model Pengajaran dan Pembelajaran (Yogyakarta: Pustaka Pelajar)
[5] David A J et al. 2009 Methods for Teaching 8th Eds (Yogyakarta: Pustaka Pelajar) 209.
[6] Oemar H 2001 Teaching Planning Based on System Approach (Jakarta: Bumi Aksara) 188
[7] Trianto 2010 Mendesain Model Pembelajaran Inovatif dan Progresif Jakarta: Kencana
[8] Kuhlthau C C et al. 2010 Guided Inquiry: Learning in the 21st Century Online: http://cissl.rutgers.edu/guided_inquiry/introduction on 17 May 2010
[9] Lubis A R and Binari M 2010 Jurnal Pendidikan Biologi (DIKBIO) 1 146
[10] Nusyamsuddin et al. 2013 Competency-Based Learning with Scientific Approach (Jakarta: The Minister of Education and Culture of Indonesia)
[11] Kemendikbud 2013 Kerangka Dasar Kurikulum 2013 (Jakarta: The Minister of Education and Culture of Indonesia)
[12] Ambarsari W, Slamet S and Maridi 2013 Jurnal Pendidikan Biologi 5 81
[13] Machin A 2014 Jurnal Pendidikan IPA Indonesia 3 28
[14] Ristanto R H 2010 Learning Based on Guided Inquiry Model with Multimedia and Real Environment Viewed from Motivation and Initial Knowledge (Thesis Universitas Sebelas Maret)
[15] Uno H B and Nurdin M 2011 Learning by PAILKEM Approach (Jakarta: Bumi Aksara)
[16] Junardi 2014 Jurnal Pendidikan Sejarah 3 1
[17] Indriana D 2011 Variety of Teaching Media Aids (Yogyakarta: Pustaka Pelajar)
[18] Putra A 2014 Jurnal Penelitian Pendidikan 5 31
[19] Wardani E R S, Johannes D and Sifak I 2014 Bio. Edu. J. 3 601
[20] Arnellis 2014 Pros. Semnas Pend. MIPA Universitas Negeri Padang
[21] Rochintaniawati D 2014 Pros. Semnas Pend. MIPA Universitas Negeri Padang
[22] Winataputra 1993 Learning Teaching Science Strategy (Jakarta: Indonesia Open University Universitas)
[23] Wahyunningsih S, Baskoro A P and Riezky M P 2012 Jurnal Pendidikan Biologi 4 33
[24] Hapsari D P et al. 2011 Jurnal Pendidikan Biologi 4 16