# HEURISTIC MODEL FOR STUDENT LEARNING IN GORONTALO

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# Abstrak

Elementary schools have undergone a phase of learning change from time to time which is influenced by the times and technological changes that continue to develop. Therefore the method, the creativity of teachers and qualified teachers plays a major role in this transformation. One of them is the learning of Natural Sciences (IPA) which has received attention, marked by the emergence of various methods, and very varied science textbooks. Science learning is also a vehicle for developing scientific attitudes as scientists do in studying natural phenomena using scientific processes and attitudes, the scientific process in question is rational observation, experimentation and analysis, with the use of scientific processes and attitudes that scientists (scientist) obtain product findings in the form of facts, concepts, principles and theories. Learning should be oriented towards student activities reflected in educational goals that a plan that contains a series of activities designed to achieve certain educational goals by using an approach to student activities or activities. This is very much in accordance with the heuristic model philosophy which emphasizes student activities as learning subjects. Science learning should emphasize student activity more dominantly than teachers, because science has a domain to help all students find their own knowledge through inquiry (inquiry) activities as a reform in learning.

### Keywords: Heuristics, Science, Scientific Attitude, Learning Outcomes

# **A. PENDAHULUAN**

Elementary schools have undergone a phase of learning change from time to time which is influenced by the times and technological changes that continue to develop. Therefore the method, the creativity of qualified teachers and teachers plays a major role in this transformation (Jana Heinz, et al, 2017). This requires updating the model in learning as a reflection of finding new ways to solve problems in educational practice (Matthias Barth, Gerd Michelsen, 2013). Various paradigms of learning models that are continuously developed by educational experts through research, scientific discussions to find good models in science education in various countries are continuously being carried out (Kai-Yu Tang, Chin-Chung Tsai, 2016). One of them is the learning of Natural Sciences (IPA) which has received attention, marked by the emergence of various methods, and very varied science text books.

Natural Science is one of the studies studied by elementary school students all over the country. The approach makes science learning meaningful, a new experience of the student learning process as an awareness of reality in scientific learning and capital for teachers as conceptual facilitators and administrators in reconstructing concepts in the teaching and learning process (Laura Colucci-Gray, et al, 2013).

Science learning is also a vehicle for developing scientific attitudes as scientists do in studying natural phenomena using scientific processes and attitudes, the scientific process in question is rational observation, experimentation, and analysis, with the use of scientific processes and attitudes. obtain product findings in the form of facts, concepts, principles and theories (Jufri, 2017: 123).

Thus a scientific attitude can be formed through science learning and one of them is through the availability of a model that accommodates these components, the results of the study provide criticism about the failure of efforts to improve the quality of education (Robert Coe, et al, 2017) because so far research has focused more on phenomena related to education, not on the things that happen in the dynamics of learning, therefore research is needed to address various problems that exist primarily inside education, namely research that is research-based problem solving. Learning should be oriented towards student activities, reflected in educational goals, that is a plan that contains a series of activities designed to achieve certain educational goals by using an approach to student activities or activities (Walid, 2017). This is very much in accordance with the heuristic model philosophy which emphasizes student activities as learning subjects. Science learning should emphasize student activity more dominantly than teachers, because science has a domain to help all students find their own knowledge through inquiry activities as a reform in learning (Rose M. Pringle, et al, 2015).

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The results of the PISA (Program for International Student Assessment) survey show that Indonesia ranks 38 out of 41 countries surveyed with an average score of 393, this is very far below Finland and Japan with an average score of 548. Furthermore, the 2003 PISA results Indonesia is still experiencing unsatisfactory results with scores of 395 from 40 countries. Where we are ranked 38, there is almost no change compared to the results in 2000. Meanwhile, 2006 has not shown any significant progress, from the results of the Indonesian PISA which still ranks 50th out of 57 countries surveyed with an average score of 393 (Hayat & Yusuf, 2010). The results of the PISA survey in 2015 began to show an increase in points compared to previous years, but were still in the top 10 from the low level or 62th rank out of 71 countries with 403 points, above Brazil but below Jordan (PISA, 2015), in 2018 out of 74 participating countries, Indonesia was ranked 69 under Panama and above Morocco with a score of 371 for reading, 379 for mathematics and 396 for science or science, (PISA, 2018).

A very diverse learning model can help teachers and students learn well, one of which is the heuristic model, where this model can help solve problems in learning and teaching difficulties in educational institutions. The combination of models contained in this model, namely inquiry and discovery, is characteristic of the heuristic model.

# **B. LITERATURE REVIEW**

### a) Heuristic Model

A model that focuses on student activeness to learn more independently or a student-centered learning model. The heuristic model implementation combines various methods including inquiry (Sagala, 2005). On the principle of the heuristic model presented by Rusyan (1993), there are various arguments as follows. 1). Student activity is the main focus in learning, 2) Think logically in finding something. 3). Press the process to find a concept. 4) A purposeful experience. 5). A person's mental development (Wisudawati & Sulistyowati, 2014).

The heuristic model emphasizes the student's experience in the learning process to be the main focus, a model that provides space for students to develop creativity but cannot be separated from the creativity of the teacher in providing various instruments to make students active in the learning process. In addition to the most important instrument, namely the method used by the teacher in one's learning process (Wisudawati & Sulistyowati, 2014). The basic consideration for applying the heuristic model is also in line with various expert opinions, among others. Confucius said that a student who experiences directly (practices / acts) will easily understand what the learning objectives are. Mel Silberman also has a similar opinion that a student can easily master the material when he is able to teach something to others. Apart from these experts, it was also reflected that the students' leaning styles (visual, auditory, and kinesthetic) were very diverse. Student-centered models are highly recommended by various groups of experts. This is the orientation of the heuristic model, but to make students active in learning, the teacher's creativity is needed in creating these conditions. Bloom's Taxonomy describes the principles of student-centered learning.

- a. In the learning process to encourage students to participate actively using cognitive and psychomotor abilities.
- b. Students are encouraged to build (construct) knowledge through data, facts, or related theories.

# 1) Inquiry

Inquiry learning is a learning activity that maximally involves all students' abilities to seek and investigate something (object, human or event) systematically, critically, logically, analytically so that they can formulate their own findings confidently. The thinking process itself is usually carried out through question and answer between teachers and students. This learning is often called heuristic learning, which comes from Greek, namely heuriskein which means "I found".

a) Steps for Inquiry Learning Implementation

The inquiry learning process is carried out through the following stages:

- 1. Formulating the problem; The abilities required are: (a) awareness of the problem; (b) see the importance of the problem and (c) formulate the problem.
- 2. Developing a hypothesis; the abilities required in developing this hypothesis are: (a) testing and classifying the data that can be obtained; (b) see and formulate the existing relationship logically; and formulate a hypothesis.
- 3. Test the tentative answers; The capabilities required are: (a) assembling events, consisting of: identifying required events, collecting data, and evaluating data; (b) compiling data, consisting of: translating data, interpreting data and classifying data; (c) data analysis, consisting of: looking at relationships, noting similarities and differences, and identifying trends, sequences, and regularities.

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- 4. Draw conclusions; The abilities required are: (a) looking for patterns and meanings of relationships; and (b) formulate conclusions
- 5. Applying conclusions and generalizations
- b) Advantages and Weaknesses of Inquiry Learning

Inquiry learning is learning that is widely recommended, because it has several advantages, including:

- 1. This learning is learning that emphasizes the development of cognitive, affective, and psychomotor aspects in a balanced manner, so that learning through this learning is considered much more meaningful.
- 2. This learning can provide space for students to study according to their learning style.
- 3. This learning is a strategy that is considered in accordance with the development of modern learning psychology which considers learning to be a process of changing behavior thanks to experience.
- 4. Another advantage is that it can serve the needs of students who have above average abilities. This means that students who have good learning abilities will not be hampered by students who are weak in learning.

Besides having advantages, this learning also has weaknesses, including:

- 1. Difficult to control student activities and success.
- 2. It is difficult to plan learning because of collisions with students' learning habits.
- 3. Sometimes in implementing it, it takes a long time so that teachers often find it difficult to adjust it to the allotted time.
- 4. As long as the learning success criteria are determined by the student's ability to master the subject matter, this strategy seems to be difficult to implement

### 2) Discovery

Learning is seen as a learning model. This departs from the statement in attachment IV of the Regulation of the Minister of Education and Culture of the Republic of Indonesia number 103 of 2014 CHAPTER IV concerning learning in primary and secondary education, it is stated that in implementing the 2013 Curriculum it is highly recommended to use based learning and problem based learning. In each of these models, attitudes, knowledge and skills can be developed. (2014: 554)

According to Kurniasih, et al (2014: 64), the discovery learning model is a learning process that occurs when the lesson is not presented with the lesson in its final form, but students are expected to organize it themselves. Discovery is finding a concept through a series of data or information obtained through observation or experiment.

a) Steps for Discovery Learning

According to Anitah (2009: 57) Discovery learning has the following steps :

1. Identify the problem

At this stage the teacher provides the opportunity for students to find and collect as many problems as possible related to the theme to be studied.

- 2. Develop possible solutions (hypotheses)
  - at this stage, students are invited to make a hypothesis on the predetermined problem.
- 3. Data collection

at this stage the teacher gives time to students to collect data related to the problem. This data can come from direct observation, the internet, books, experiments, or other sources.

4. Data analysis and interpretation

At this stage the students analyze the data from their findings, then develop a statement to support the data. After that the data were tested for hypotheses and concluded. 5. Test conclusions

after there is a conclusion from the students, new data appears and at this stage the results of the conclusions are tested. If there is a shortage, the conclusion can be revised.

b) Pros and Cons of Discovery Learning

Advantages

- 1. Helping students to improve and enhance cognitive skills and processes. The discovery effort is key in this process, depending on how one learns to learn.
- 2. The knowledge acquired through this model is very personal and powerful because it enhances understanding, memory and transfer.
- 3. Generating pleasure in students, because of the growing sense of investigating and succeeding
- 4. This model allows students to be able to develop quickly and at their own pace.
- 5. Causing students to direct their own learning activities by involving their own intellect and motivation

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- 6. This model can help students strengthen their self-concept, because they gain confidence in working with others.
- 7. Student-centered and the teacher actively issues ideas / ideas. Even teachers can act as students and as researchers in discussion situations.
- 8. Helping students eliminate skepticism (doubt), because it leads to final and certain or certain truths.
- 9. Students will understand basic concepts and ideas better
- 10. Assist and develop memory and transfer to new learning process situations
- 11. Helping students think and work on their own initiative
- 12. Helping students think intuition and formulate their own hypotheses
- 13. Give decisions that are intrinsic
- 14. The learning process situation is more challenging
- 15. The learning process includes aspects of the students towards the formation of a whole human being
- 16. Increase the level of appreciation in students
- 17. The possibility of students learning by making use of various types of learning resources
- 18. Can develop individual talents and skills

Deficiency:

- 1. This model raises the assumption that there is a readiness of the mind to learn. Students who are less intelligent will have difficulty abstracting or thinking or expressing the relationship between written or spoken concepts, which in turn will cause frustration.
- 2. This model is inefficient for teaching a large number of students, because it takes a long time to help them find theories or other problem solutions.
- 3. The expectations contained in this model can be shattered against students and teachers who have become accustomed to old learning methods
- 4. Discovery teaching is more suitable for developing understanding, whereas for developing aspects of concepts, skills and emotions as a whole it gets less attention.
- 5. In some scientific disciplines, for example, science lacks facilities to measure the ideas put forward by students.
- 6. Does not provide opportunities for thought that will be found by students because it has been chosen by the teacher.

# b) Learning Science

# 1) Principles of Learning Science

Science is one of the most important subjects that is always given at every level of education. Science was developed as an integrative science subject which has the meaning of combining various aspects, namely the cognitive, affective, and psychomotor domains. Science learning in the 2013 curriculum emphasizes the use of a scientific approach which includes observing, questioning, experimenting, associating and communicating (Resmawati, Prabowo, Munasir, 2018). Science learning is an interaction between students and their surroundings. This results in science learning need to prioritize the role of students in teaching and learning activities. science learning needs to apply proper learning principles. Suparno, (2010: 20-21) describes some of the principles of science learning in elementary schools as follows:

- 1) Four pillars of global education, which include learning to know, learning to do, learning to be and learning to live together. Learning to know, meaning that by increasing student interaction with their physical and social environment, students are expected to be able to build understanding and knowledge about the natural surroundings. Learning to do, meaning that science learning does not only make students listeners but empower students to want and be able to enrich their learning experience. Learning to be, meaning that from the results of interaction with the environment, students are expected to be able to build self-confidence which in turn forms their identity. Learning to live together, meaning that the opportunity to interact with various individuals will build an understanding of a positive attitude of tolerance towards diversity in life together.
- 2) Inquiry principle, this principle needs to be applied in science learning because basically students have great curiosity, while the natural surroundings are full of facts or phenomena that can stimulate students to want to know more. Thus, the knowledge and skills obtained by students are not the result of remembering a set of facts, but the results of finding themselves from the facts they face.
- 3) The principle of mutual cooperation (science, environment, technology and society), Science has the principles needed for technology development. While technological developments will spur the discovery of new science principles.

- 4) The principle of problem solving, basically in everyday human life is always faced with various kinds of problems. On the other hand, one measure of a student's intelligence is largely determined by his ability to solve problems. Therefore, science learning needs to apply this principle so that students are trained to solve a problem.
- 5) Learning Principles with Value, the community and the environment have values that are maintained and need to be respected. Therefore, science learning needs to be carried out wisely so that it does not have a negative impact on the environment or contradict the values that the surrounding community stands for.
- 6) PAKEM principles (active, creative, effective and fun learning), this principle is basically a learning principle oriented towards active students to carry out activities both active in thinking and activities that are motor in nature.

2) Characteristics of Natural Science Learning

Science is a discipline that has the same characteristics as other disciplines. Every science has characteristics or characteristics in general or specifically. In general, the characteristics of IPA are a set or collection of facts and rules that state the relationship between one another. These facts are arranged systematically and stated in precise and definite language so that they are easy to find and understand for communication. (Prawirohartono, et al 1989: 93). the special characteristics are described as follows ;

- 1) Science has scientific value: it means that the truth in science can be proven again by everyone by using scientific methods and procedures as previously done by the discoverers.
- 2) Science is a collection of knowledge that is arranged systematically and in general its use is limited to natural phenomena
- 3) Science is theoretical knowledge, meaning that science is obtained or arranged in a special or special way, namely by making observations, experimental, inference, theory preparation, observation and so on.
- 4) Science is a series of interrelated concepts which means that conceptual charts have developed as a result of experiments and observations, which are useful for experimentation and further observation.
- 5) Natural Science includes four elements, namely products, processes, applications, and attitudes, meaning that products can be in the form of facts, principles, theories, and laws.

### c) Scientific Attitude

A scientific attitude is an attitude or action that must arise from students who are based on experiences and insights in interacting with new phenomena, such as the attitude of a scientist in conducting research to gain knowledge. Someone who is scientific is a person who has seven kinds of scientific attitudes, namely: 1), a curious attitude; 2). Critical attitude .; 3). Open attitude .; 4). Be objective; 5). A willingness to respect other people's work. 6). Dare to defend the truth. 7). Attitude to reach forward.

Furthermore, some scientific attitudes were put forward by Brotowijdoyo, (Hendracipta, 2016) which is usually done by experts in solving problems based on the scientific method, as follows:

- 1) An attitude of curiosity, meaning that when he faces a new problem, he tries to find out; enjoy asking questions about objects and events; the habit of using the sense organs as much as possible to investigate a problem.
- 2) Critical attitude, which means not just accepting conclusions without strong evidence; the habit of using evidence when drawing conclusions; don't feel the most righteous that other people should follow; willing to change his opinion based on strong evidence.
- 3) Objective attitude, which means seeing something as the object is; keep away personal biases and are not controlled by his own thoughts; say honestly and distance his interests as subjects.
- 4) An attitude of wanting to discover, which means always providing suggestions for new experiments; the habit of using experiments in a constructive and sound way; always provide new consultations from the observations made.
- 5) An attitude of respect for others, meaning that he will not recognize and view other people's work as his work; accept scientific truth even though it is found by other people or other nations.
- 6) Diligent attitude, meaning not tired of conducting investigations; willing to repeat experiments whose results are dubious; will not stop doing activities if it is not finished; against things he wants to know he tries to work with precision.
- 7) Open attitude, meaning being willing to listen to other people's arguments even if they differ from what is known; open to receiving criticism and negative responses to the opinions of others.

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S. Karim A. Karhami (1990) suggests that scientific attitudes that tend to be developed in various schools are:

- 1) Curiosity (curiosity); Characterized by high student interest. Here, children also often try to experience new experiences. Curiosity is often characterized by asking questions.
- 2) Flexibility (flexible attitude); the attitude of students in understanding new concepts, new experiences, according to their abilities without any difficulty. Usually this understanding takes place gradually.
- 3) Critical reflection (critical attitude); The habit of students to reflect and review activities that have been carried out.
- 4) Honest attitude; Students' honesty to themselves and others in completing or trying new experiences. Honesty is important because it can be used to find out students' real abilities (Purwaningsih 2007: 18).

### d) Learning Outcomes

According to Woordworth (Majid, 2014: 28) learning outcomes are changes in behavior as a result of the learning process. Woordworth also said that learning outcomes are actual abilities that are measured directly. The results of this learning measurement will finally find out how far the educational and teaching goals have been achieved.

Sudjana (2014) argues that learning outcomes are abilities that students have after receiving their learning experiences. According to Howard Kingsley (Sudjana, 2014) divides three kinds of learning outcomes, namely: 1) skills and habits, 2) knowledge and understanding, 3) attitudes and ideals. Each type of learning outcome is filled with materials that have been determined in the curriculum. According to Majid (2014: 27) student learning outcomes are essentially a change in behavior after going through the teaching and learning process. Behavior as a result of learning in a broad sense includes the cognitive, affective, and psychomotor fields.

# **C. RESEARCH METHOD**

### 1) Type of Research

This research is a research design that is oriented towards a mixed method between quantitative and qualitative methods by following the four D procedures or models (define, design, develop, and desiminate) developed by (Thiagarajan, Semmel, and Semmel, 1974). The approach in this research is a development approach with an R & D design. This research is designed to produce a science learning book based on a heuristic model in elementary schools.

### 2) Research Procedure

a. Preliminary studies

This research is a research design that is oriented towards a mixed method between quantitative and quantitative methods by following the four D procedures or models (define, design, develop, and desiminate) developed by (Thiagarajan, Semmel, and Semmel, 1974). The approach in this research is a development approach with an R & D design. This research is designed to produce a science learning material based on the heuristic model in elementary schools.

b. Model development

In more detail, developing research procedures using the Four D development model with stages including define, design, delvelop and disseminate. In detail, the stages of this development model are described as follows.

- 1) Initial research and information gathering. This activity includes needs assessment, literature review, small research and reviewing the latest research results related to the model to be developed.
- 2) Planning. This stage includes defining skills that must be learned, identifying learning activities, and due diligence on a small scale.
- 3) Develop the initial format of the product. At this stage, it involves the development of teaching materials, assessment procedures and instruments, lesson plans and learning media
- 4) Initial field test. At this stage the field exam is carried out on a limited basis and on a small scale
- 5) Revision of the main product, namely making revisions to the product model in accordance with the results of previous initial field tests.
- 6) Main field test. In the field test stage, it was carried out more broadly and on a larger scale.
- 7) Revision of the product operationally. At this stage revisions are made to the product model in accordance with the results of previous field tests.
- 8) Operational field test. At this stage the development results model that has been carried out is applied at the field level with standard operational procedures in accordance with the condition settings as this product will later be applied and without assistance by researchers.
- 9) Revision of the final product. At this stage the product model to be produced is revised for the last time before being implemented.

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- 10) Dissemination and implementation. This stage is the last stage, where the product is perfect to be communicated with all related parties and then implemented.
- c. Evaluation / model testing phase Evaluation and improvement of the final product is deemed necessary for more accurate product being developed. At this stage, we get a product whose quality level can be accounted for. The results of this final product improvement will have a reliable "generalization" value. In this case,

the heuristic learning model can be used in all 4th grade elementary schools in Limboto District.

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