

IMPROVING KNOWLEDGE OF HEREDITY CONCEPT USING DISCOVERY-INQUIRY METHOD: AN EXAMPLE OF CLASS-ROOM ACTION RESEARCH

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ABSTRACT: This Class-room action research was aimed at overcoming pedagogical problems in the teaching of heredity concept using discovery-inquiry method among the students of XII grade (IPA-1) of MAN 1 Purwokerto. It was conducted in three teaching cycles. Each cycle consists of four actions, they were: planning, acting, observing and reflecting. The result showed that students' knowledge in understanding the concept of heredity pattern increased. This increase was shown by some indicators, like the improvement of teaching activities, the rise of student participation in the teaching process as well as the progress of students' learning achievement scores. Observation or investigation activities increased from 32.5% to 55%. Meanwhile, finding or searching activities increased from 28.75% to 50% and the activities of concept formulation increased from 13.7% to 25%. Contributive participation in asking questions increased from 15% to 37.5% and contributive participation in giving opinion increased from 11.25% to 27.50%. Furthermore, contributive participation in rebutting increased from 1.25% to 11.25%, while initiative participation in doing exercises increased from 40% to 68.75%. It was concluded that in this class-room action research, the use of discovery-inquiry method could improve the knowledge of heredity concept among XII grade students of MAN 1 Purwokerto.

KEY WORDS: discovery-inquiry method, improving knowledge, contributive participation, initiative participation, and learning achievement.

INTRODUCTION

Biology is one of the main subjects taught at senior high school level. Most of the materials in biology are about the life of organisms, so biology has a close relationship with students themselves and their surrounding (Sastrodiroto, 1985). The presentation of the materials can also be understood easily. That is why these factors attract those

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who are interested in biology? Unfortunately, the current teachings activities lead students to merely memorize biology teaching materials. They do not develop students' understanding nor make them think about how to apply those materials. As a consequence, biology is not an interesting subject for them. Students show a little interest in biology. What makes things worse is that biology learning process needs high analytical thinking (Sudargo, 2003). The difficulties in studying biology materials are mainly found in some materials dealing with the concept of life. One of the biology materials related to the concept of life is chapter "Heredity Patterns".

Chapter of Heredity Patterns requires students understanding as well as their analytical thinking. The basic competency in this chapter is students should understand the basic components of genetic and relate them to the heredity process from parents to their offspring (Depdiknas, 2004). As stipulated in the instructional objective of this chapter, students are required to be able to apply their understanding about heredity concept in some living organism from parents to their offspring.

Unfortunately, in the teaching process of heredity concept, students have some difficulties because the taught materials are abstract. Therefore it needs a high analytical ability. Meanwhile the current teaching activities are done by introducing some models of genetic substance by presenting DNA model, chromosome picture, and diagram of hereditary patterns. In such method, the implication of the concept taught using those instruments is not effective. As a consequence, the students do not have a good understanding about the material. They understand heredity concept theoretically but they are not able to apply it in daily life.

THE PROBLEM OF RESEARCH

The XII grade students of IPA (*Ilmu Pengetahuan Alam* or Natural Science) – 1 of MAN (*Madrasah Aliyah Negeri* or Islamic Senior High School) – 1 in Purwokerto, Central Java, Indonesia experience such difficulties. The daily test data showed that students' knowledge about heredity concept is still low. One factor that causes students' low understanding about chapter Heredity Patterns is inappropriate teaching method in presenting the materials. Moreover, the lack of learning facilities and media becomes another factor. Teacher's explanation about heredity patterns is given as material to be memorized. In addition, teacher only shows the picture of DNA and chromosome models. Analytical ability in such process is ignored. Meanwhile the students only listen to their teacher's explanation without active participation during teaching process. It prevents students from gaining ability in analysis and synthesis on the materials being studied.

In order to solve this problem, a teaching method variation that is suitable for the topic of discussion is needed (Ali, 1983; Sunaryo, 1984; Sudjana, 1987; and Suryabrata, 1993). Discovery-inquiry method can be an alternative in this case. This method can be used to improve students' analytical thinking as well as their involvement in the teaching process. Discovery-inquiry method is a teaching method that involves all students' capacities, so it can explore students' curiosity about the studied matters (Purwanto, 1990; Suharyono, 1994; and Ihsan, 1995).

As young learners, senior high school students' are very curious about everything. Therefore in the learning process, students' curiosity should be maintained and encouraged so that they will be critical and ask critical questions about the object and material being studied, such as: "*what, why, how and what will happen if something happens?*". In a more advanced level, this method can explore students' ability to develop their process skill, such as: asking a question, guessing the answer, planning an investigation, doing an experiment, processing the data, evaluating the results and communicating their findings to others in many ways (Depdiknas, 2004).

Discovery-inquiry is a teaching method that promotes the students to develop their analytical capability and creates an interaction between the concepts they have acquired and the findings or new evident they find. In such a way, students' understanding about a concept through a process and exploration method can give the students a better "new concept understanding". Finally, the application of discovery-inquiry method can stimulate students' mind and their analytical thinking in studying heredity patterns, so students' understanding about the concept of heredity patterns can be optimized (Sudaryo *et al.*, 1987; and Slameto, 1995).

The problem statement of this class-room action research is: "*Could the XII grade of (IPA-1) of MAN 1 Purwokerto Students' knowledge about heredity concept be improved using discovery-inquiry method?*". Based on that problem statement, the problem source as well as the solution of this problem can be predicted as follows:

Problems	Problem Source	Action solutions
Students' involvement in the teaching process can be categorized as low.	Teaching method is classical. Teaching method ignores students' learning activities and active participation.	The application of discovery-inquiry method in the teaching process of heredity concept.
Students' process skills in asking question, making hypothesis, designing investigation, doing experiment, processing data, evaluating data and communicating observation results can be categorized as low.		
Students' motivation and their level of understanding are low.		

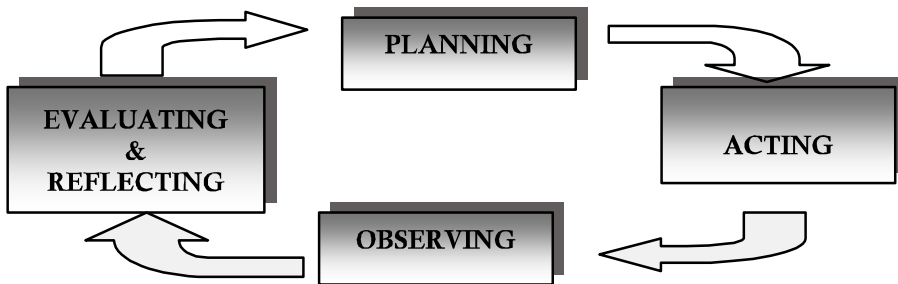
The indicators of the success of this class-room action research are:

Problems	Indicators
Students' involvement in the teaching process can be categorized as low.	Students' active involvement in the teaching process increased.
Students' process skills in asking question, making hypothesis, designing investigation, doing experiment, processing data, evaluating data and communicating observation results can be categorized as low.	Students' process skills in asking question, making hypothesis, designing investigation, doing experiment, processing data, evaluating data and communicating observation results increased.
Students' motivation and their level of understanding are low.	Students' motivation and their level of understanding increased.

This class-room action research was aimed at increasing students' knowledge about the concept of heredity patterns using discovery-inquiry method. Meanwhile the benefits of the development of this innovation are: (1) **for the students**, it increases students' knowledge and skill in understanding the concept of heredity patterns; (2) **for the teachers**, it increases teachers' skill both in identifying and in solving teaching problems in the class. It also increases teachers' skill in developing innovation in the class; and (3) **for the school**, it increases human resources quality in teaching process and in developing teaching method and its variations, so the teaching quality can be improved (Wardhani, 2004; and Wiriaatmadja, 2007).

THE RESEARCH PROCEDURE

The classroom action research was conducted at MAN (*Madrasah Aliyah Negeri* or Islamic Senior High School) 1 in Purwokero, Central Java, Indonesia. The design of this study adopts Kurt Lewin's action research pattern in which each action cycle consists of: (1) planning; (2) acting; (3) observing; and (4) evaluating and reflecting (in Arikunto, 1998; Stigler & Hiebert, 1999; Sukidin, Basrowi & Suranto, 2002; Wardhani, 2004; and Wiriaatmadja, 2007).



In detail, the procedure of the study can be described as follows:

*First, **Planning.*** It is the procedure in which steps of learning process are determined. It comprises: (1) Selecting discovery-inquiry learning method to improve students' knowledge in the teaching process of chapter of Heredity Patterns; (2) Selecting the order of teaching materials and objectives; (3) Arranging teaching planning and the indicators of achievement for each cycle; (4) Creating and completing learning media; (5) Creating observation sheet to observe students' activities and learning process; and (6) Designing instrument of evaluation which are suitable for the teaching objectives.

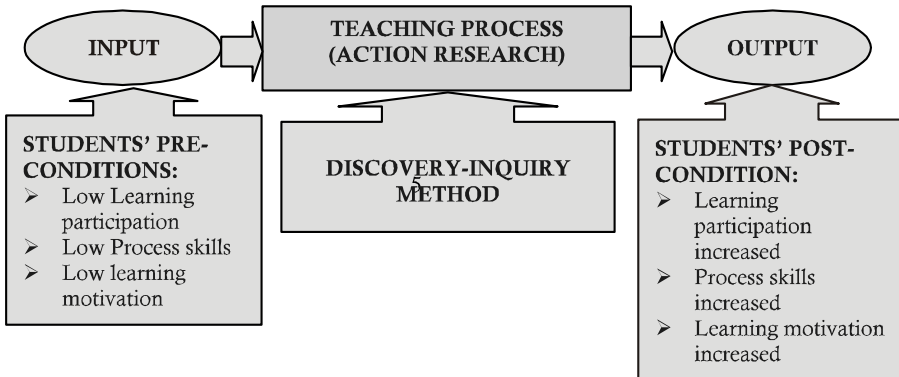
*Second, **Acting.*** Conducting learning activities in which previously decided teaching model and design are used.

*Third, **Observing.*** In this phase, acting phase is observed by using well-prepared observation sheets.

*Fourth, **Evaluating and Reflecting.*** The data during observation are collected and analyzed. The result of data analysis is used as the reflection of previous teaching

activities. In this phase, the extent of students' knowledge increase can be assessed. Based on the result of reflection, some weaknesses from the previous teaching activities can be identified for the consideration in deciding the class action in the following cycle.

In order to ease the understanding of this class-room action research, a concept mapping is designed as follows:

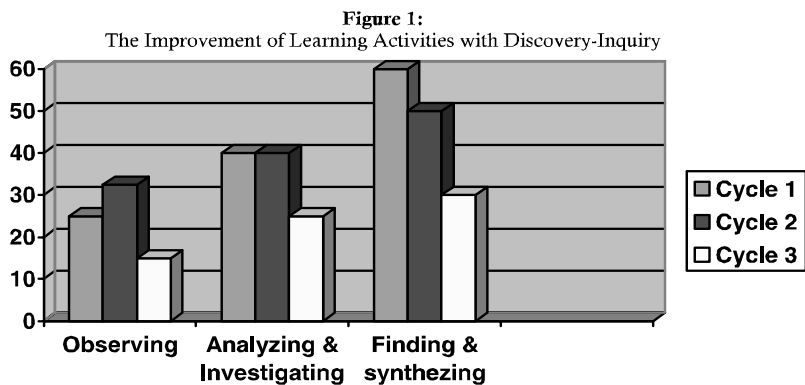


RESULTS AND DISCUSSIONS

Generally said that the teaching of chapter Heredity Patterns using discovery-inquiry method could improve students' knowledge and understanding about heredity concept. This improvement could be seen from students' greater involvement in learning process

Table 1:
Students' Learning Activities during Learning Process with Discovery-Inquiry Method

Students' Activities	Activity Percentage (%)		
	Cycle 1	Cycle 2	Cycle 3
Observing picture/diagram/model/media	25	40	60
Observing/analyzing/investigating	32.5	40	50
Finding and synthesizing the concept	15	25	30



that drove them to get a better learning achievement about the concept of heredity (Sastrodiroto, 1985; and Kartasapoetra, 1987). Activity improvement as the realization of students' knowledge and understanding could be seen from the observation result in each cycle. Students learning activities in the teaching process increased from cycle 1 to cycle 3. It is shown in Table 1 and Figure 1.

Meanwhile, students' active participation in the form of both contributive and initiative participation improved from cycle 1 to cycle 3. It is shown in Table 2 and Figure 2, and Figure 3.

Table 2:
 The Increase of Students' Active Participation in the Teaching Process Using Discovery-Inquiry Method

Contributive Participation	Activity Percentage (%)		
	Cycle 1	Cycle 2	Cycle 3
Asking questions	17.5	27.5	40.0
Giving opinions	12.5	25.0	30.0
Giving rebuttals	2.5	5.0	12.5
Initiative Participation	Cycle 1	Cycle 2	Cycle 3
Doing exercises/tasks	42.5	52.5	75.0
Active Participation	Cycle 1	Cycle 2	Cycle 3
Doing data collecting process	-	37.5	40.0
Questioning and answering in discovery and investigation process	-	25.0	50.0
Communicating the findings	-	35.0	40.0

Figure 2:
 The Increase of Students' Contributive Participation in the Teaching Process as an Indicator of the Increase of Students' Knowledge

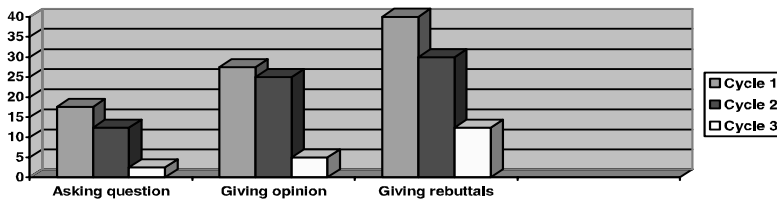
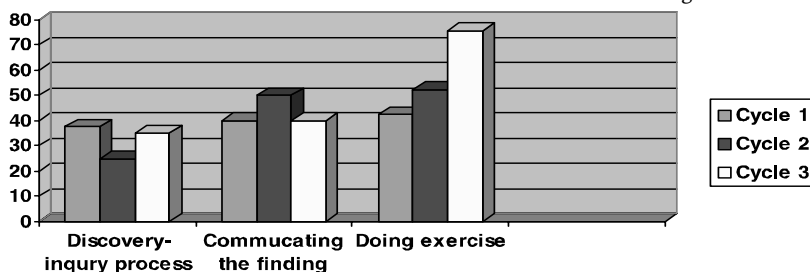


Figure 3:
 The Increase of Students' Active Participation and Initiative Participation in the Learning Process as Indicators of the Increase of Students' Knowledge

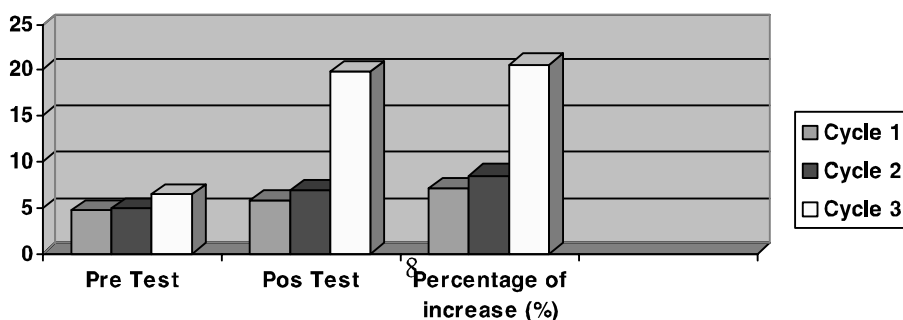


The increase of students' learning activities and active participation in the teaching process led to the increase of students' knowledge which was shown by the increase of students' achievements. The percentage of the increase of learning achievement in cycle 1 was 6.45%. It increased to 19.30% in cycle 2 and to 20.62% in cycle 3 (Table 3 and Figure 4).

**Table 3:
The Percentage of Students' Learning Achievement Increase in the Teaching Process Using Discovery-Inquiry Method**

Test Type	Cycle 1	Cycle 2	Cycle 3
Pre-test	4.65	5.75	7.08
Post-test	4.95	6.86	8.54
Percentage of the increase (%)	6.45	19.90	20.62

**Figure 4:
The Diagram of Learning Achievement Increase during the Teaching Process**



Based on the data in table 3, it shows that the teaching process using discovery-inquiry method could improve students' knowledge and understanding. It in turn increased students' Biology achievement. Students' activities in the teaching process increased and a better cooperation in group work appeared. This condition motivated the students to develop their affective, cognitive and psychomotor competencies. Students' competencies increased if they participated well in the teaching process (Nasution, 1996; and Asy-Syakhs, 2001).

Discovery-inquiry method was applied since this learning method considers students' competencies development. This learning approach allows the students' to understand as well as to develop the learning concepts more easily. Students' knowledge and skill stimulate their intrinsic motivation, since they are satisfied with their capability. Based on the evaluation results, discovery-inquiry method was less effective for big classes because it would spend longer time (Arikunto, 2001). Moreover, if that big class was not guided well, it could cause ambiguousness and vagueness to the studied materials. The teachers are required to be well-prepared. It includes their readiness to create work sheets and exercises (Djamarah & Zain, 2002).

CONCLUSION

Based on the above results and the discussions, it can be concluded that discovery-inquiry method could increase students' knowledge about the concept of heredity patterns.

The teaching process using discovery-inquiry method should consider the following: (1) It requires better and more careful preparation and planning that comprises lesson planning, learning media and evaluation instruments; (2) The teachers should master the variation of teaching method to increase students' motivation and interest in learning activities. It is important to increase students' achievement; and (3) Students' activities and involvement should become the focus of teaching process.

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