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THE USE OF PROBLEM SOLVING MODEL IN THE MATERIAL OF THE GENETIC INFORMATION FLOW TO IMPROVE THE STUDENTS' CONCEPT MASTERY

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ABSTRACT

The purpose of this research was to determine the implementation of the IDEAL (Identify, Define, Explore, Anticipat and Act, Looking Back and Learn) problem solving model of Bransford (1998) on the lecture material flow of genetic information, its influence on the mastery of conceps. The method uses quasi-experimental research with pretest-posttest nonequivalent control design. The results of the research show that : (1) the lecture model of problem solving IDEAL on the material flow of genetic information can implemented very well in each stage; (2) had a significant influence on student mastery of concepts; (3) in each of the indicators developed, the experimental class, it is known that the lectures with a problem-solving model of the flow of information on the subject of genetically high yield category on several indicators; (4) gives effect to the problem solving ability of students.

Keywords: flow of genetic information; the IDEAL problem solving model; mastery of concepts

INTRODUCTION

One of the courses in the Chemistry Education program at the University related to biochemical is a bio molecular metabolism. The bio molecular metabolism consists of a catabolism and a bio molecular anabolism reaction. One of the topic in the bio molecular anabolism is protein biosynthesis or the genetic information flow. Based on the final test result comes from some lectures who teach biochemical, it is concluded that the students' score for this topic is low. The observation result shows the mean score for the question of the genetic information flow is 62, 65; the lowest score is 44 and the highest score is 81 from the total score 100. According to the final score, it shows that the concepts mastery, especially the topic of the genetic information flow, needs to be improved. The topic of the genetic information flow ia a part of the protein metabolism, that is the biosynthesis protein.

Mari (2012) in her research of lectures investigation who teach biochemical states that the topic is considered difficult to master. The topic of the genetic information flow comes from the series concept which relates each other. It relates to the daily life experience such as inheriting a genetic characteristic and bio technology. To study that material, prerequisite knowledge is needed, like the nucleotide structure such as DNA and RNA, the function of cell organelles and enzyme. So, it will be difficult to the students to understand this material if they are not practicing it frequently. The difficulty in the biochemical lectures, especially the genetic information flow can be handled by using the right lecturing model such as the problem solving model which stimulates the students to think creatively in solving the problem. In the end, the students' concept mastery in this material is expected to be better improved. The problem solving model, according to

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Bransford is known as IDEAL model.

According to Bransford (1998) the IDEAL problem solving model aims to improve lectures and creativity. The stages in the IDEAL model if it is developed further and connected to the dimension of knowledge and cognitive process result the correlation of every stage in the IDEAL model containing the stages in the dimension of knowledge and cognitive process. In the Atan and Ismail's research (2011), the data show that the students agree if the problem solving model gives many advantages and benefits to them to master the knowledge, to improve the acquisition and to express the habit. Meanwhile, Karatas and Baki (2013) state the problem solving model can improve the students' skill in solving the problem. Based on the explanation above, the aim of this research is to investigate the use of IDEAL problem solving model and its effect, based on the Bransford's point of view, on the students' concept mastery and on the skill to solve the problem during the genetic information flow lectures.

METHOD

This research was conducted in one of the Educational Institution for Educators in Bandung. The sample of this research is the students of the chemistry education semester VI, there are 62 students which divided into two groups, 32 students as the experimental group and 30 students as the control group. The research method used in this research is Quasi-Experiment, involving the sample of the experimental group and the control group (Fraenkel and Wallen, 2006). Then, in this research, the pretest and posttest score were compared. The treatment is given to the experimental group which is the problem solving model, while the control group is using an inductive model such as lecturing and discussing. The research design used in this research is *pretest-posttest nonequivalent control design*. This is a quasi-experiment research design which gives the test before and after receiving the treatment (Fraenkel and Wallen, 2006).

The data were collected using an observation sheet, a cognitive test measurement device, a problem solving exercise. It illustrates in the Table 1.

The techniques of data analysis are (1) the observation sheet analysis: the observation sheet is completed by the observer and analyzed qualitatively. On the observation sheet, the observer is giving point started from "very good" until "lack". After that, the points from every stages are analyzed, discussed, and summarized. (2) The result of the cognitive test analysis: the data such as pretest, posttest, and gain score were analyzed.

RESULT AND DISCUSSION

The IDEAL problem solving model is including five stages, they are identifying the problem, designing the problem solving, exploring the problem solving strategy, anticipating and solving the problem, and also evaluating the problem solving that is implemented in the genetic information flow material. This material is part of the biochemical material that is bio molecular metabolism. To learn this material, previously, the students must provided with the basic knowledge of the nucleotide structure, both the DNA and the RNA.

This research was discovered that the problem solving model is well-implemented in the

Table 1. Techniques of Data Collection

No	Data Collecting	Source of the Data	Implementation	Aim
1	The Observation Sheet	Teacher	during the lectures session	To get the illustration on how the problem solving model is implemented in the topic of genetic information flow
2	Cognitive Test Measurement Device	Students	Before and after the lectures session	To get the illustration on how the students master the concept of the genetic information floe topic
3	Problem Solving Exercises	Students	After the lectures session	To get the illustration on the problem solving skill of the genetic information flow

topic of genetic information flow which has no relation with the mathematic calculation (Bowen and Bodner, 1991). The concept in this material is the series of various concepts theory needed to master by the students in order to connect the problem solving to the society fact. This finding is not separated from various aspects that support the implementation of the model. According to the observation result, it is known that the lectures involvement in assisting the students when completing every stage, by giving a reference or teaching material to them to complete every problem solving stages. By using the teaching material, it helps the lecture, as a facilitator. Eventually, the students can complete all the stages contained in the students' worksheet.

The article on the students' worksheet discusses on how to identify a corpse, this theme is an actual discussion which widely published recently. Si, it makes the students feel enthusiastic in solving the problem contained in the students' worksheet and relates it to the existing fact in the society. Based on the implementation of the IDEAL problem solving model, it is resulted: (1) the students are able to identify the problem well, in this case how the biosynthesis protein processes from the DNA fragment. In this lectures activity, the ability to identify the problem is the main achievement of the problem solving model. So, when the students are able to find the problem at the first stage by a group discussion, they can find the alternative problem solving easily based on the references that they have. (2) the students are involved actively in finding an exact solution for the given problem and making the best solution (Cardellini, 2006). (3) By using the module or handout, the students along with their group search various alternative biosynthesis protein process, they mention kind of process that can produce a protein forming with the known DNA fragment. (4) the students work together as a group to solve the problem, it can be seen from their active discussion in order to complete every problem solving stage in the worksheet. (5) to finish the problem solving is started from the problem identification of biosynthesis protein to the evaluation of the biosynthesis protein process by seeing the genetic code table, in fact it would be hard for them if they work it individually. This problem solving model offers the students a motivated environment so that they can learn as much as possible (Cardellini, 2006). Based on the result, it can be concluded the the IDEAL problem solving can be well-implemented in the topic of genetic information flow.

According to the research finding, the data of concept mastery is shown on the Table 2.

From the Table 2 the mean score of the students who receive the treatment in the experimental group and the students who become the control group has improved. The improvement for the experimental group is 79,7% and the control group is 56,9%. It means that, generally, the concept mastery at the both class are increasing. The hypothesis test was done through the normality test and homogeneity test of the gain mean score on the both group. The result of the normality test with the kolmogorov smirnov test using the IBM SPSS version 20 finds that in the experimental group the gain score which is on the significant level of 5% is 0,056, because of 0,056 > 0,05 so the gain score of the concept mastery of the students in the experimental group in a normal distribution. The normality test in the gain mean score in the control group of the concept mastery is in the 5% significant level which id 0,175 because of 0,175 > 0,05 so it says that the concept mastery in the control group is also in a normal distribution.

Ho in this research does not show a significant discrepancy on the concept mastery in the topic of genetic information flow both in the experimental and control group. It is clearly seen that the F for the gain in the concept mastery in

Table 2. The Concept Mastery in the Experimental and Control Group

Score		Group	
		Experimental	Control
Pre-test	The number of the student	32	30
	Minimum	0	0
	Maximum	30,8	38,5
	The mean score	8,7	14,1
Post-test	The number of the student	32	30
	Minimum	23,1	38,5
	Maximum	100	84,6
	The mean score	81,5	63

both class is 0,084 with probability of 0,773. Because the probability score is higher than o,05, the population variety (gain) in both group is homogenous. The hypothesis test is using t test with the help of *IBM SPSS software version 20* because the distribution data is normal. The t test uses *independent sample t test*, the decision making in the t test analysis can be done based on the comparison of probability score and the significant score. Because of the probability (Sig. (2-tailed)) is 0,000 and this score is fewer than 0,05, so Ho is declined and H_a is accepted, it means that there is a significant discrepancy in the concept mastery of the genetic information material in he experimental group and control group. In short, the lectures using the problem solving method in the genetic information flow topic gives a considerably influence.

The lectures of the genetic information topic consist of seven cognitive indicators such as: describing the DNA replication process, describing the DNA transcription process into the mRNA, describing the mRNA translation process into the amino acid, implementing the transcription and translation on the protein biosynthesis, relating the concept of genetic information flow through DNA test, examining the result of the amino acid sequence in the biosynthesis protein into the DNA sequence, designing the nucleotide sequence (DNA) from the specific peptide fragment. Every indicator is analyzed its achievement based on % gain which calculated previously from the pretest and posttest in the experimental and control group. The improving of concept mastery in each indicator in both groups is shown on the Table 3.

Based on the gain mean score (%) of the concept mastery in the genetic information flow material in every indicator, it is concluded that the lectures using the problem solving model in the topic of genetic information flow is more increasing the level of the students' concept mastery than that of using the conventional lecture such as lectures and discussing.

That discrepancy is based on the hypothesis test that states the considerably significant occurred between the experimental and the control group (Karakas and Baki, 2003). The students' concept mastery is measured with the cognitive test measurement device. The device was given to the students either in the experimental or control group. Generally the improvement of the concept mastery is occurred either in the experimental group that receive the problem solving

Table 3. The Gain Mean Score (%) in Mastering the Concept in Experimental and Control Group Topic: the genetic Information Flow in each Indicator

No	Indicator	The Gain Mean Score in Experimental Group	Category	The Gain Mean Score in Control Group	Criterion
1	Describing the DNA replication process	81,25	High	45,161	Fair
2	Describing the DNA transcription process into the mRNA	62,5	Fair	16,129	Low
3	Describing the mRNA translation process into the amino acid	34,375	Fair	41,935	Fair
4	Implementing the transcription and translation on the protein biosynthesis	81,51	High	65,05	Fair
5	Relating the concept of genetic information flow through DNA test	100	High	93,55	High
6	Examining the result of the amino acid sequence in the biosynthesis protein into the DNA sequence	79,69	High	62,9	Fair
7	Designing the nucleotide sequence (DNA) from the specific peptide fragment	59,375	Fair	29,032	Low

treatment, or in the control group which receive an old school way of teaching such as lecturing or discussing. This occurrence is shown from the gain score (%), in the experimental group the score 79,7 % and the control group is 56,9 %.

According to the gain criteria, the experiment group has High category while the control group is a Fair category. As a result, the lectures applying the problem solving model can improve the students' concept mastery better than that of the lectures using discussion or explanation. This finding is resulted from the model of problem solving such as (1) including the stages that stimulate and give the students chance to understand the material (Dimmock, 2000). It is based on how the students describe the various concepts of the genetic information flow they just learned by reading the teaching material, then it helps them to complete the cognitive test after the lectures be done. (2) helping the students in increasing their content ability and contextually (Barakat and BouJaode, 2003). It can be viewed at the worksheet article which describes the fact of the genetic information flow process that is identifying corpse. In this exercise, the students are given a question on how to connect the genetic information flow to the DNA test (indicator 5), in fact, the students got the perfect score 100. In describing the replication DNA process (indicator 1), implementing the transcription and translation on the protein biosynthesis (indicator 4), and examining the result of the amino acid sequence in the biosynthesis protein into the DNA sequence (indicator 6) are categorized into High category. It means the lectures through the problem solving model helps the students to understand the concept well. The result in the cognitive test in the following category is categorized Fair and the indicators are describing the DNA transcription process into the mRNA (indicator 2), describing the mRNA translation process into the amino acid (indicator 3), and designing the nucleotide sequence (DNA) from the specific peptide fragment (indicator 7). In the indicator 2, the students must be able to describe the DNA fragment sequence, if they have not understood the difference structure of DNA and mRNA, it will be difficult for them to reach this indicator. The Fair category got in this indicator is assumed as a result that the students have not mastered all the prerequisite concept of the genetic information flow.

In the indicator 3, the students also got Fair category. This category demands the students to accomplish the indicator 2 whereas in the indicator 2 the students did not complete it excellently so in indicator 3 they met a difficulty in finishing the exercise.

In the indicator 7, the students have to be able to designing the nucleotide sequence (DNA) from the specific peptide fragment and it needs the concept mastery in the genetic information flow comprehensively. By getting this fair category it means that the students have not mastered the concept well so it is quite hard to complete the indicator well.

The success of the use of the problem solving model is in accordance with the Wood statement; making the students work together to solve the problem, they are involved actively in a group of the study to solve the exercise in the students' worksheet starting from identifying the problem of protein biosynthesis and evaluating the protein biosynthesis protein by viewing the genetic code table. It would be difficult if they work individually (Wood, 2006).

Applying the IDEAL problem solving model in the genetic information flow lectures includes some problem solving which must be done by the students. to Figure out the students' skill in the solving the problem, a test was done in giving the question and article in every problem solving skill level similar to students' worksheet. The article is discussing the process of the genetic information flow relating to the genetic finding. The students' response in this exercise is used to measure their ability in solving the problem.

According to the data gathered from Table 4, it is concluded that the problem solving model of lectures improves the students' ability in solving the problem. It also encourages them to complete and finish the problem, and finally it improves their skill in solving the problem (Dogru, 2008). Every stage in the problem solving model stimulates the students to solve the problem creatively starting from identifying until evaluating the problem solving. The students are able to solve the problem; it is shown by viewing the mean score in every stage problem solving which is high. So, it is concluded that the students are having the skill in solving the problem (Bransford, 1998). The students' skill in solving the problem relates to the problem solving model which encourage them to improve their conceptual material understanding the improvement of the problem solving skill.

CONCLUSION

Based on the research finding and discussion, it can be concluded as follows: (1) the IDEAL problem solving model is well-implemented in the topic of the Genetic information flow along with

Table 4. The Result of the Problem Solving Process in the Topic of the Genetic Information

No.	The steps of problem solving	The problem solving process in the genetic information flow	The mean score %
1.	Identifying the problem	Describing the problem of the protein biosynthesis process from the DNA sequence	76,6
2.	Defining the alternative purpose	Designing the protein biosynthesis process strategy	93,8
3.	Exploring the problem solving strategy	Choosing the protein biosynthesis process strategy correctly	96,9
4.	Anticipating and behaving the problem	Implementing the chosen strategy in the protein biosynthesis process	96,9
5.	Evaluating the problem solving	Re-examine the protein biosynthesis process from the DNA sequence by comparing the genetic code table	98,5

its every stage. (2) the model gives a significant influence to the students in mastering the whole concept and each developed indicator. Based on the result of the gain mean score in mastering the concept in each indicator on the experimental group, it is shown that there are four indicators which is categorized High, such as explaining the process of DNA replication, applying the transcription and translation of protein biosynthesis, relating the concept of the genetic information flow to the DNA test, and examining the result of the amino acid sequence of the protein biosynthesis to the DNA sequence. The three indicators which are categorized Fair, are explaining the transcription process of DNA to mRNA, describing the translation of mRNA to the amino acid, and designing the nucleotide sequence (DNA) from the specific peptide fragment. (3) the IDEAL problem solving model in the topic of the genetic information flow can increase the students 'problem solving skill excellently.

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