ISBN 978-602-19877-3-5

PROCEEDING

THE INTERNATIONAL CONFERENCE ON MATHEMATICS, SCIENCE, EDUCATION AND TECHNOLOGY

ICOMSET 2015

Education, Mathematics, Science and Technology for Human and Natural Resources

October 22, 2015

Inna Muara Hotel and Convention Center
Padang, Indonesia

Published by :
Faculty of Mathematics and Science
State University of Padang
Padang, Indonesia

Address:
Faculty of Mathematics and Science
State University of Padang
Jl. Dr. Hamka Air Tawar Padang - Sumbar

The International Conference on Mathematics, Science, Education and Technology

(ICOMSET 2015)

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BIOLOGY EDUCATION STUDENT ACCEPTANCE OF EVOLUTION THEORY BEFORE LEARN EVOLUTIONARY COURSE IN BIOLOGY DEPARTMENT

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ABSTRACT

Studies on student acceptance of the theory of evolution have been conducted intensively in American and Western countries. This study purpose was to measure university students' acceptance of evolution in Indonesia, especially West Sumatera. This article reported a preliminary research to know biology education student acceptance of evolution before learn Evolutionary course in Biology Department, Faculty of Mathematics and Science, State University of Padang. Data collected using the MATE instrument by Rutledge and Warden (1999) that given to 37 biology education students who will take Evolutionary course in the second semester of 2015. The result showed that those students acceptance of evolution theory was 60.81%. This study concludes that biology education student acceptance of evolution theory before learning evolutionary course is in the low categories of acceptance. This condition is discussed and proposed some suggestions.

Index Termss — Biology Education Students, Acceptance of Evolution, Evolutionary Course

1. INTRODUCTION

Evolution is a knowledge which strongly controversy among public around the world, because of people's misunderstood on it [8]. The rejecting of evolution often relies on the misconceptions to evolution [15].

Despite the evolutionary concept have been more effectively proven by the molecular explanation [2], in United States, several studies reveal that many Americans have a poor understanding of evolution and reject it as a valid scientific theory (Gallup, 1993; Recer, 1996; cited in [11]). Whether citizens of the United States are less belief on evolution, citizens of Europe and several non European nations more believe on evolution [5]. But, it does not mean that all of them accept evolution. As the effect, a big range of misconceptions happens on learning evolution at school and even at the university students around the world.

Studies on student acceptance of evolution have been conducted intensively [14]. This kind of study is important to known by teacher or lecturer, because some studies suggest that there are two possibilities for people on evolution [8]. Firstly, people believe in evolution but do not understand on it. Secondly, people have understood about evolution theory, but do not accept evolution. It makes there are separately of knowledge and acceptance in learning evolution.

On the one hand, research has shown that student acceptance of evolution positively associated with their understanding of biological evolution in final grades (Ingram and Nelson, 2006 cited in [14]). On the other hand, some studies showed that there is little or no relationship between knowledge of natural selection and acceptance of evolution (Walter, Halverson, and Boyce, 2013). Although it is the fact in some countries, the relationship in Indonesia does not known yet. Therefore, this survey conducted to measure students' acceptance of evolution and the factors that influence it.

2. PURPOSE

This study purpose was to measure university students' acceptances of evolution. It was a preliminary research to know biology students' acceptances on evolution. This research will be the basic information for the follow up that should be carried out by lecturer when teaching evolution theory. Thus, our study assessed students' acceptances before they learn evolutionary course at Biology Department. The research question guiding this investigation was: "What is the level of acceptance of evolution theory among biology students before they learn evolutionary course at Biology Department?"

3. METHOD

3.1. Participants

The participants of this study were biology education students who will take Evolutionary course in the second semester of 2015 at Biology Department, Faculty of Mathematics and Science, State University of Padang. On this semester, there are two classes, but on this study only one class as the participants, in amount of 37 students.

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3.2. Measures

The Measure of Acceptance of the Theory of Evolution (MATE) instrument [10] was used to measure participants' acceptance in evolutionary theory. This instrument consists of 20-item questionnaire which questions as follow:

1. Organisms existing today are the result of evolutionary processes that have occurred over millions of years.
2. The theory of evolution is incapable of being scientifically tested.
3. Modern humans are the product of evolutionary processes that have occurred over millions of years.
4. The theory of evolution is based on speculation and not valid scientific observation and testing.
5. Most scientists accept evolutionary theory to be a scientifically valid theory.
6. The available data are ambiguous (unclear) as to whether evolution actually occurs.
7. The age of the earth is less than 20,000 years.
8. There is a significant body of data that supports evolutionary theory.
9. Organisms exist today is essentially the same form in which they always have.
10. Evolution in not a scientifically valid theory.
11. The age of the earth is at least 4 billion years.
12. Current evolutionary theory is the result of sound scientific research and methodology.
13. Evolutionary theory generates testable predictions with respect to the characteristics of life.
14. The theory of evolution cannot be correct since it disagrees with the Biblical account of creation.
15. Humans exist today in essentially the same form in which they always have.
16. Evolutionary theory is supported by factual historical and laboratory data.
17. Much of the scientific community doubts if evolution occurs.
18. The theory of evolution brings meaning to the diverse characteristics and behaviors observed in living forms.
19. With few exceptions, organisms on earth came into existence at about the same time.
20. Evolution is a scientifically valid theory.

The MATE instrument uses a five points of Likert scale ranging:

a. Strongly Agree
b. Agree
c. Uncertain
d. Disagree
e. Strongly Disagree

The MATE is scored using composite values from the 20 items with the lowest level of acceptance being 20 to the highest level of acceptance being 100. To determine comparative levels of acceptance, Rutledge (1996) as stated in [10] provides the following scores and categories:

89-100 = Very High Acceptance
77-88 = High Acceptance
65-76 = Moderate Acceptance
53-64 = Low Acceptance
20-52 = Very Low Acceptance.

The MATE items have been tested based on the reliability and validity to assess high school biology teachers' overall acceptance of evolution [10]. This instrument also have tested its reliability in using for university students, suggest that the MATE is a reliable instrument which appropriate for assessing our participants' acceptance of the theory of evolution [11]. This instrument also recommended by [14] as one of the four instruments to classify levels of student acceptance that have reviewed on his qualitative research.

3.3. Analyses

To account for positively and negatively-phrased items, the scaling of responses must be appropriately reversed so that responses indicative of a high acceptance of evolutionary theory receive a score of 5 while answers indicative of a low acceptance receive a score of 1.

Step 1. Scoring of items 1, 3, 5, 8, 11, 12, 13, 16, 18, and 20 is as follows:
Strongly Agree = 5
Agree = 4
Undecided = 3
Disagree = 2
Strongly Disagree = 1

Step 2. Scoring of items 2, 4, 6, 7, 9, 10, 14, 15, 17, and 19 is as follows:
Strongly Agree = 1
Agree = 2
Undecided = 3
Disagree = 4
Strongly Disagree = 5

Step 3. An individual score on the MATE is equal to the sum of the scaled responses to all 20 items. [11], (p.335).

4. RESULTS

This study presents biology education students' acceptance of evolution theory before learn evolutionary course in Biology Department by the concepts addressed by the MATE [11]. The data presents in Table 1.

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Table 1.Biology Education Students' Acceptance of Evolution Theory

CONCEPT	ITEMS	%
Process of evolution	1, 9, 18, 19	10.94
Scientific validity of evolutionary theory	2, 10, 12, 13, 14, 20	19.81
Evolution of humans	3, 15	6.54
Evidence of evolution	4, 6, 8, 16	10.71
Scientific community's view of evolution	5, 17	6.73
Age of the earth	7, 11	6.08
	SUM	**60.81**

This data shows that biology education students' acceptance of evolution theory is in the low acceptance criteria (in the criteria 53-64%).

5. DISCUSSION

This study presents that biology education students' acceptances of evolution theory before learn it in the university level is low category. This data consists of six criteria of evolutionary concept, and it re-arranged which percentage from the highest to the lowest as follow.

5.1. Scientific Validity of Evolutionary Theory, Process of Evolution, and Evidence of Evolution

Scientific validity of evolutionary theory concept got the highest percentage of acceptance by biology education students (19.81%), because they learned it at the senior high school. The students think that evolutionary theory is scientific, based on their basic knowledge from senior high school. It follows by the concept about process of evolution and evidence of evolution. This fact shows that teacher teach it at their school.

The free comments which filled by the students showed that the evolutionary concepts which students still remember from the highest level to the lowest until this data collected were:

a. Evolutionary changing = 81.08%
b. Natural selection = 40.54%
c. Heredity = 32.43%
d. Darwin and Lammarck theory = 27.03%
e. Speciation = 13.51%
f. Abiogenesis and biogenesis = 10.81%
g. The origin of life = 2.70%

Those concepts discuss by the teacher based on the evolution curricula in Indonesia. It proves to the students that evolution is a scientific theory which facilitated with some evidence.

Difference with Indonesian curricula, American has seven tendency of evolutionary topic, as the instrument developed by Bilica (2001) cited in [12] using TETS (Teaching Evolutionary Topic Survey). [12] Survey to the private school teachers used TETS showed that teachers tend to teach these seven topics with the percentage as follows:

a. Diversity = 84.2%
b. Natural selection = 81.6%
c. Speciation = 75.0%
d. Evidence of evolution = 59.2%
e. The speed of evolutionary process = 51.2%
f. Heredity modification = 44.7%
g. Human evolution = 30.2%

Based on those seven topics, only three topics that same with Indonesian curricula; natural selection, speciation, and heredity. The diversity in Indonesian curricula is included on evolutionary changing, as the result, it creates diversity of organisms.

Despite the different, the approach of teaching evolution understands more on the concept with low controversy on it, such as: diversity, natural selection, and also speciation. Those make the result of this study seems to be logic, because the students understand that evolution is a scientific theory which some concepts are provable.

5.2. Scientific Community's View of Evolution, Evolution of Humans, and Age of the Earth

These three topics are quite controversial among public, and students in this study also showed it. They gave lower percentage of acceptance on it. This condition formed by some possibilities. Firstly, their teacher never discussed this aspect at the senior high school. There is no explanation about scientific community view of evolution in the school. As the effect, the students do not understand about this topic, and also about evolution of humans and age of the earth. [12] Survey reported that on these three topics, American private teacher tend to do not discuss it in their class, because it do not linked with religiosity.

Different with United States, in Indonesia, the students do not learn about it because of those topics are not synchronize with the curricula. Based on Indonesian curricula document, evolution is in the 3.9 Basic Competences: Analyze about evolution theory and natural selection with the new view of speciation in the earth based on literary study [9].

5.3. Influencing Factors of Students' Acceptances

Student acceptance indicates that their acceptances influenced by varied factors. The dominant factor is the way of teacher taught them in the senior high school level. This fact also suggested by Carlesen (1991) cited in [7], teachers' understanding about a subject, will affect their way of teaching.
Students explained that most teachers taught evolutionary topic by lecture strategy only. It makes

ISBN 978-602-19877-3-5

the students difficult to understand and the time to discuss it also very fast. The other strategy that teachers used was discussion, recorded, reading, doing worksheet, individual task, and debriefing. The teachers rarely used this alternative strategy, and just little teachers explain evolution in the appropriate time. This condition makes students understanding of evolution are low.

Students' understanding of evolutionary concept got some misconception from their teachers' explanation. As Thompson and Logue (2006) cited in [15], there are possible ways for student to develop misconception such as through parents, media, teacher, and others. Jarvis and colleagues (2003) cited in [8] reported that the teachers having misconceptions tend to teach their misconceptions to their students. It indicates that an educator will influence the students' understanding, conceptions, and also acceptance. This happens because teacher tends to teach what they were taught (Deemer, 2004; Kikas, 2004; Llinares & Krainer, 2006; cited in [8].

The ideal action that teacher must do when teaching evolution is teach evolution based on the right concept, and cultivate student wisdom for learning evolution. Individual wisdom is associated with experience, spirituality, and passion [3]. Therefore, students' experiences when learn evolution is the important aspect to change student acceptance on it.

The other factors that influence student acceptance of evolution are: evolution concept, religions, the difficulties of theory, students' curiosity, validity of references, the explanation in the textbook, evidences in daily life, scientists' ideas, and individual views on evolution.

Research conducted by [13] reported that students' acceptance of evolution is most often considered as a product of an individual's views of science and religion. When students perceive a conflict between their religious beliefs, students prefer holding on to their religious beliefs [6]. However, the data above differ with this survey result, which show teachers explanation for the majority factors that affect evolution. Less than 10% student on this study reported that their belief make them do not want to learn about evolution.

From the aspect of evolution conception, many studies have documented that once individuals shifting a conception (whether it is correct or incorrect), this person tends to argue on it briefly and resist receiving other perspectives, even it completes with evidences (Mason & Limon, 1999; Sinatra & Pintrich, 2003) cited in [8]).
This data correspondingly with several factors that affect learning and students' performance in education; related to teachers, students and others. The factor that related to teachers is adequacy in professional knowledge, teaching style, attitude, sympathy, language skill, etc. The factors that related to students are ability, attitude, need, learning styles, working memory capacity, and motivational styles, etc. Others factors such as physical situation, assessment methods, and socio-cultural factors [1].

Increasing the standard of learning evolution, United States' scientist had evaluated the factors that important to consider, such as: the selection of textbooks, the adequacy of teachers' own knowledge, and the organization of curriculum [4]. These factors have to be considering by Indonesian teacher to increase students' understanding about evolution concept and changing their conceptions.

5.4. The Effect of Student Acceptance of Evolution to Their Motivation of Learning Evolution in the University

According to [8], (p.15), low acceptance of students on evolutionary theory, "…, this presents a significant barrier for learning and teaching the scientific view of evolution." In addition, [14] also pointed out that a lack of acceptance of evolution may contribute to negative learning experiences about it, such as lower instrinsic motivation, less interest, higher anxiety, and more emphasis on grades.

It is different with our data. On one hand, despite the students' understanding of evolution are low based on their concept from senior high school, most biology education students are interested to follow Evolutionary course in the university level. They want to follow this course with different reasons. Majority students want to learn evolution because they have high curiosity to know the correct answer and explanation. They are generally in doubt with evolution theory, although some of them like this topic since senior high school because evolution consists of interested discussion and fact.

The other reasons that make students interested on evolution are because evolutionary concept also makes students become open minded and remind students about our origin and the origin of life.

On the other hand, some students told that they do not interested on learn evolution, because this topic quite confusing, difficult to understand, the evidences are rarely happen in daily life, and do not believe that evolution processes are really happen.

Biology education students claim that they have high motivation to follow Evolutionary Course because they want to make their misconception about evolution from senior high school become right conception. Misconception is an important factor that affects learning [1].

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In addition, the students also think that this course is very important to follow, because they will teach evolutionary topic after they graduated from the university. Understanding evolution concept in the university will help them when teaching evolutionary topic at the school. Therefore, they have to understand evolution well, in order to teach evolution better for the next time.

As [8] (p.16) cited: "Since teachers are products of the educational system, it is anticipated that they would also hold misconceptions of evolution". Therefore, it will be more effective to prepare university students who will teach evolution with conceptual shifts in their acceptance of evolution theory [8]. As the follow up, lecture have to make biology education students increase their understanding of evolution, to cut the chain of misconception of evolution from the school.

The other reason to learn evolution by the students are because much knowledge can learn from this course and some benefits can get by learning evolution for the way of people thinking by analyzing the changing in organism and life.

6. CONCLUSION

Biology education students' acceptances of evolution theory before learn Evolutionary Course in Biology Department, Faculty of Mathematics and Science, State University of Padang is "Low Categories of Acceptance". The majority factor that affects it is the way of teacher taught the students about evolution at senior high school, which combine with other factors such as evolution concept, religions, the difficulties of theory, students' curiosity, validity of references, the explanation in the textbook, evidences in daily life, scientists' ideas, and individual views on evolution. Despite biology education students have low acceptance on evolution; they have high motivation to learn evolution in Evolutionary Course of Biology Department, by the most reason because they have high curiosity to know the correct answer and explanation about evolution and they also consider to teach this topic next time when they are being a biology teacher.

7. SUGGESTIONS

The discussion of this study suggest for:

a. Teachers to teach evolution in the right strategy, in the appropriate way, in the suitable time, and cultivate individual wisdom of learning evolution.
b. All educators have found the alternatives to increase student acceptance and understanding of evolutionary theory.
c. All biology teachers have to make a whole and integrated understanding of evolution, to make the diversity of biology giving completely to the next generation.

8. ACKNOWLEDGEMENTS

This research conducted with some suggestions from my colleagues Muhyiatul Fadilah and Fitri Arsih who kindly supported me in many ways. I also give my thanks to my chairman of Biology Department for the support to publish this article.

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