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SE-002

MISCONCEPTION ON BIOLOGY MATERIALS AMONG BIOLOGY TEACHERS AND SCIENCE STUDENTS OF SENIOR HIGH SCHOOL IN NORTH SUMATRA

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ABSTRACT :

Conceptual understanding is very important in learning. The presence of misconception is one of the important barriers in understanding biology. The objective of this study was to detect the presence or absence of misconception among biology teachers and science students of Senior High School in North Sumatera. Public schools (10 schools per area) were randomly sampled according to their nature of location, either in urban, suburban or rural area. Teachers (15) and their science students (250) were proportionally sampled from schools in each area. A two dimensional diagnostic test was used to detect the presence or absence of misconceptions on biology materials, both in teachers and their science students. The results show that no area of study is totally free from misconception, both for teachers and students, and that the misconception is increased from urban to rural area of study. Students in rural area show bigger misconception problem for all the six concepts than that of both urban and suburban areas. The problem of misconception is much more minor in biology teachers. Data also indicates that urban and suburban students make less frequent misconception than their counterpart in rural area. More than 60% of teachers in urban and suburban areas are free from misconception compared to less than 50% for the teachers in rural area. The results indicate that misconception is a general problems both in students and biology teachers..

Keywords: *Misconception, students, teachers, high school biology concepts, conceptual barrier.*

INTRODUCTION

According to the constructivism, the role of the old concept is very critical to help the students to be capable of understanding the new informations or experiences during learning process (Wittrock, 1974; Hand & Treagust, 1991; Duffy & Jonassen, 1991). Students construct their own knowledges and concepts in such a way that correspond to their existing capability and experiences. Hence, one of the learning objective in science is to help students to understand the concepts of science and to make them meaningful and the use them to explain natural phenomenons or to break out the actual problems they deal with (Kara & Yesilyuart, 2008). By this theory, to be succeded in learning or in solving the actual problems a student should be able to understand the concepts of science they learn before.

Factually, several studies indicate that students enter the class with various misconception problems (Tekkaya, 2002; Ekici & Ekici, 2007; Kose, 2008). In science, misconception can be detected in all levels of education, in all domains (or subjects) either in biological sciences (Marek *et al*., 1994), physics (Clement, 1987; Gilbert *et al*.,1982; Mohapatra, 1988), or chemistry (Penddley & Brets, 1994). In biology for example, students' misconception has been reported on vertebrate and invertebrate (Braund, 1998 *in* Tekkaya, 2002), structure and function of cell (Brown, 1990; Kinfield, 1991; Smith, 1991; Steward *et al*., 1990), photosynthesis (Ekici & Ekici, 2007; Kose, 2008), circulation and excretion systems (Din-Yan, 1998), respiration in plants (Boo, 2007; Kose, 2008) an human being (Michael *et al*., 1999; Pabucu & Geban, 2006), nervous system (Odom, 1993), genetics (Brown, 1990; Hacklig & Treagust, 1984; Peard, 1983; Smith, 1991; Steward & Dale, 1989; Steward *et al*., 1990), protein synthesis (Fisher, 1983) and evolution (Catz *et al*., 2010).

Students' misconception can be originated from various sources or factors, for eaxample from daily life experiences (Head, 1982), medium language for instruction (Bergquist & Heikkinen, 1990), teachers, inappropriateness in teacher and student knowledges (Hodge, 1993), changes in scientific terminologies (Schmidt, 1999; Schmidt *et al*., 2003), textbooks (Stake & Easley, 1978), and many others sources or factors. Thereby, misconceptions are extreemly affected by, and related with, students' life background, both socio-culturally and academically. Because of the sources and factors of misconceptions are so many and varied, then the potency of students (even school teachers) to be misconceptied is very high.

There are two main characters of misconcention should be profoundly taken into account by the executors in education (or teachers) (Ben-Zvi *et al*., 1986; de Vos & Verdonk, 1987; Haidar & Abraham, 1991; de Posada, 1997; Demircioglu *et al*., 2005). *Firstly,* misconception is resistant to the change, persistant and very difficult to be corrected or eleminated even with a special learning process designed to cover the misconceptions. *Secondly,* as a consequence of the first character, students with misconceptions could be experienced with many significant obstacles in the next learning process that suppress their actual capability (Demircioglu *et al*., 2005). Therefore, misconception could be a latent danger in learning. Misconception is a latent danger because its presence can not be detected until met a challenge from new other concept (Simanek, 2007).

When misconception can not be detected and characterized and seriously handled early then it can cause an inefficiency in learning process because the wrong concepts will be maintained by the students, and then the new concepts delivered by the teachers in the next learning process will be hindered by the wrong one. Therefore, ideally a student and/or a teacher should be cleaned out firstly the old and wrong concepts before introducing new

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concept. If the problem of misconception already be solved well then an efficient learning process could be expected.

The objective of this study was to detect and identified the presence or absence of misconceptions on biology materials among the biology teachers and science students of Senior High School in North Sumatera. The presence of data on teachers and students misconception in biology is at need in order to search and develop appropriate teaching methods or models to overcome misconception ifself.

METHODOLOGY

Time, location and subject of study. The study was held from March to November 2014 in North Sumatera, involved biology teachers and class XI science students of Senior High Schools.

Population and sample. Population of this study was all biology teachers and their class XI science students of public Senior High Schools in North Sumatera. Schools were categorized into three different groups, based on its location, either in urban (located in Medan, Tebingtinggi, Binjai, and Pematangsiantar), suburban (Sibolga, Gunungsitoli, Padangsidempuan, Tanjungbalai, all capital city of kabupaten, Deliserdang, and Langkat), or in rural area (all Kabupaten except its capital city, i.e. Asahan, Batubara, Dairi, Humbahas, Karo, Labuhanbatu, Labuhanbatu Selatan, Labuhanbatu Utara, Mandailing Natal, Nias, Nias Barat, Nias Utara, Nias Selatan, Padanglawas, Padanglawas Utara, Padanglawas Selatan, Pakpak Barat, Samosir, Serdangbedagai, Simalungun, Tapanuli Selatan, Tapanuli Tengah, Tapanuli Utara, and Tobasamosir).

One capital city of kabupaten or kabupaten (or kota) was randomly sampled from each area, i.e. Medan for urban, Deliserdang for suburban and Labuhanbatu Utara for rural area. Ten schools were then randomly choosen to represent each area from which 15 biology teachers and 200 class XI science students were proportionally sampled from each school as the subject of the study.

Instrument. A two dimensional diagnostic test (Klomkowsky *et al*., 2006) was developed to detect the presence or absence of misconception among the teachers and students. Test was a multiple choice which is structurally consisted of a question or statement and followed by five alternative answers, and then by the confirmation on the level of certainty to the choosen answer. Instrument was consisted of 6 questions, one question for each main concept of biology materials for class XI science students. Instrument was then validated to the experts and then tried out to the limited number of biology teachers (10) or class XI science students (50) outside the study samples before use in the study.

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Detection of misconception. Teachers or students were asked to take the test in a specially prepared room in their own school. The chairs in the room was arranged in such a way as to prevent the the teachers or students to interchange their answers. Test was initiated by a 5 minutes introduction on the test from researcheres and followed by a 30 minutes period for partisipants to answer the questions in the instrument. The same instrument was used both for teachers and students. Researcher was in the test room during the test takes place.

RESULTS AND DISCUSSION

Results. Figure 1 shows mean diagnostic score on six biology concepts identified for biology teachers and students of Senoir High School sampled from three different study areas in North Sumatera. Maximum score for this test is +3 (no misconception) while score below +1 indicates misconception. Figure 1 clearly shows that no area of study is totally free from misconception, both for teachers and students, and that the misconception is increased (as the score is decreased) from urban to rural area of study. In fact, the score of both teachers and students sampled from rural area is lower than overall mean score.

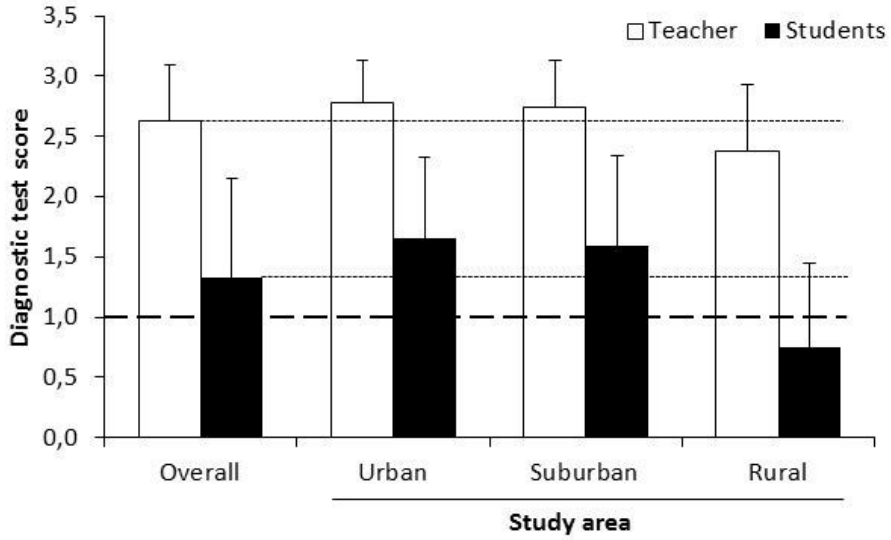

Figure 1. Mean (± SD) diagnostic test score of biology teacher and student of Senior High School in North Sumatera. Teachers (*n* = 15) and students (*n* = 200) were sampled from each three different study areas. Both teachers and students from rural area showed lower score than overal score. Score below the bold dashed line indicates misconception.

In order to better understand the location of conceptual problem among the six biological concepts under study, teachers and students scores are analysed for each concept (Figure 2). As can be see in Figure 2A, concept number 6 is the most frequently miconceptized by the

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students, either in urban, suburban or rural area of study. This is then followed by the concept number 3 and 5 in the second and third positions. Students in rural area show bigger misconception problem for all the six concepts than that of both urban and suburban areas. The problem of misconception is much more minor in biology teachers (Figure 2B). In fact, for concept number 1, biology teachers are totally free from msiconception.

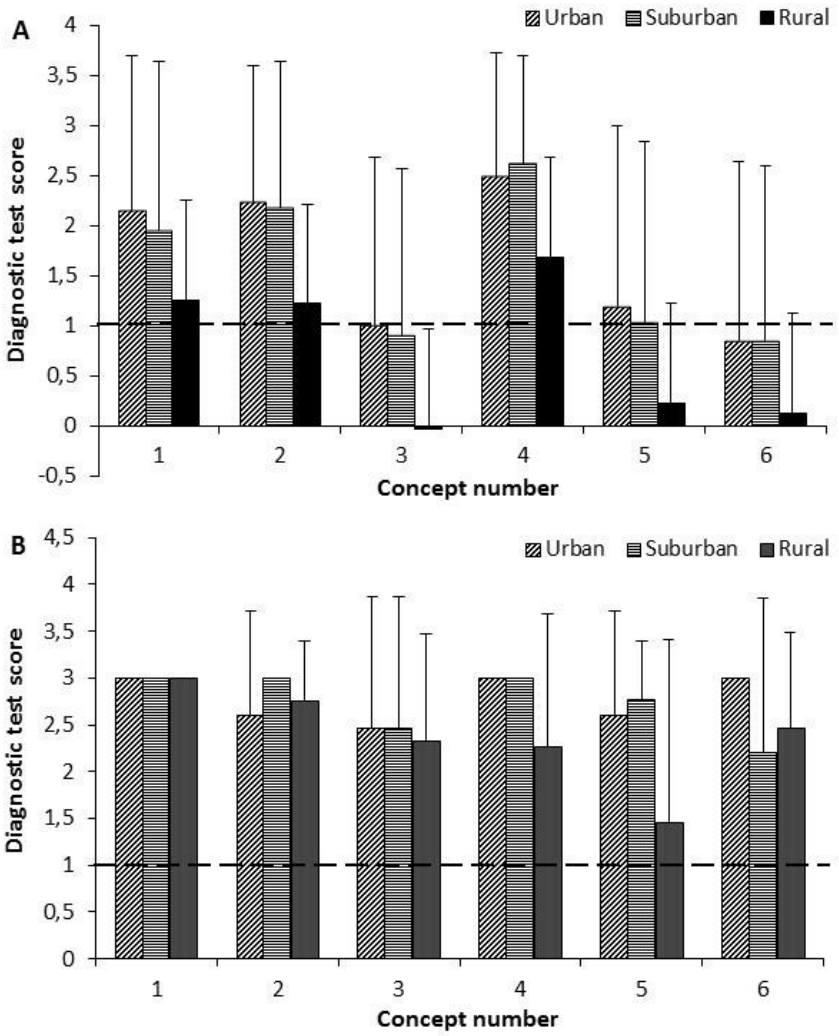

Figure 2. Mean (± SD) diagnostic test score of science students (A) and biology teachers (B) of Senior High School in North Sumatera. Score are distributed for each concept to elaborate the location of misconception. No students' misconception was found in concept number 1, 2, and 4, but all students show serious misconception in concept number 6. Rural area students have most frequent misconception than suburban and urban. Among the teacher, no misconception was detected on the six concepts. Teachers (n = 15) and students (n = 200) were sampled from each three different study areas. Score below the bold dashed line indicates misconception.

Figure 3 shows the distribution of students and teachers according to the mumner of concepts they misconcetized. The distribution is different between urban and suburban students in one part (with right skew-like distribution) and rural students in the others (with left skew-like

distribution) (Figure 3A). This type of distribution indicates that urban and suburban students make less frequent misconception than their counterpart in rural area. For biology teachers (Figure 3B), more than 60% of them are free from misconception (for urban and suburban areas) compared to less than 50% for rural areas. In addition, 10% of rural teachers are experienced misconceptions in two concepts under study while maximum misconception in urban and suburban teachers is one concept.

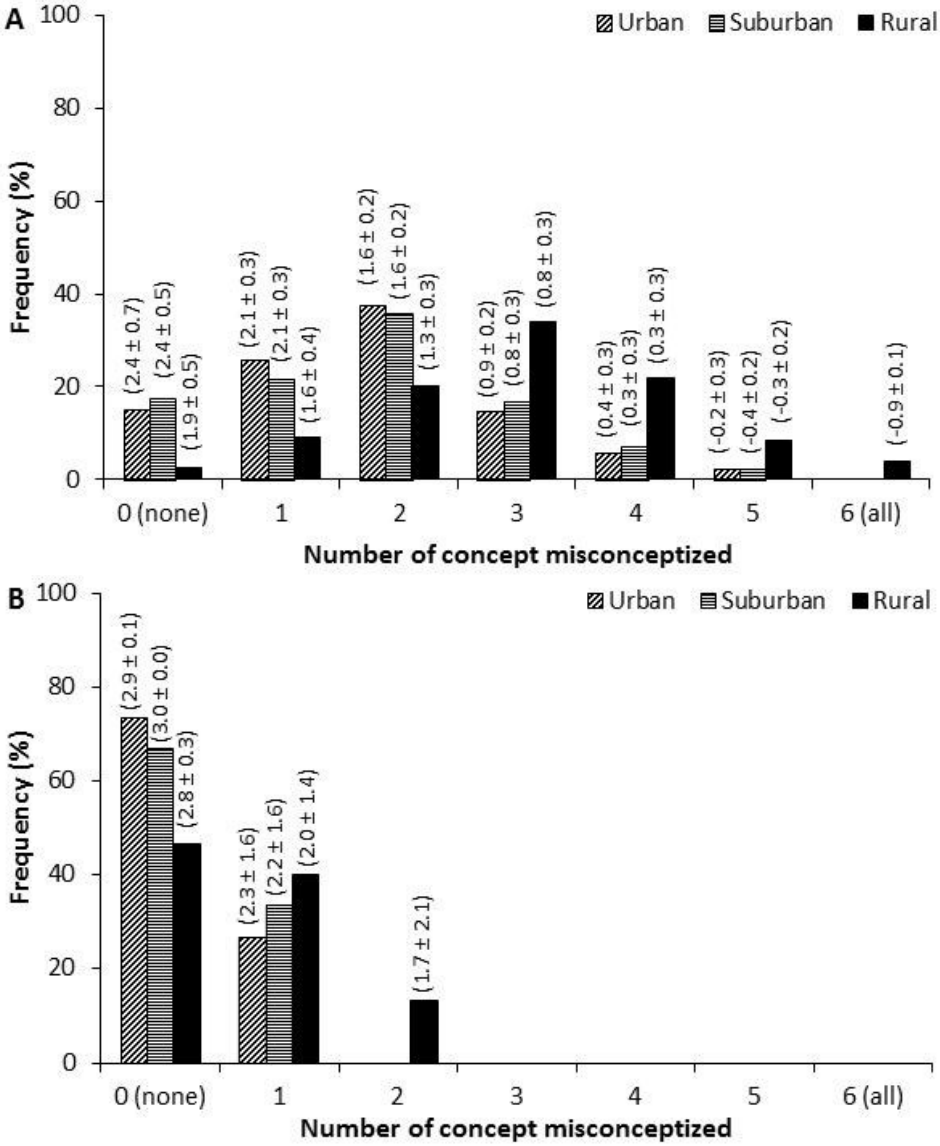

Figure 3. Distribution of students (A) and biology teachers (B) according to the number of concept they misconceptized (number in parenthesis indicates the mean (± SD) score for each group of concept misconceptized). Urban and suburban students show right skew-like distribution which are different from rural students with left skew-like one. More than 60% of urban and suburban teachers are free from misconception compared to less than 50% for rural teachers. Teachers (n = 15) and students (n = 200) were sampled from each three different study areas.

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Discussion.This study reveals that both teachers and students are hold misconceptions on biology materials although the level of misconception is much higher in students than teachers.

At least there are three important things to be noted from this study. Firstly, misconception is universally occured, not only in school students but also in teachers. Universality of misconception has been formerly reported elsewhere (Palmquist & Finley, 1997; Yip, 1998; Alters & Nelson, 202; Kikas, 2004; Nehm & Schonfeld, 2007). Even, several studies revealed that some of students' misconceptions are originated from their own teachers (Alters & Nelson, 202; Yates & Marek, 2014). The possibility of misconcenption transfer from teacher to students will be increased in the schools that implement conventional teaching or teacher-centered teaching and learning models.

Secondly, in the context of North Sumatera, the prevalence of misconception among the school teachers can be attributable to the community diversity in etnic, language and religions. Perhaps teachers' misconceptions can also be the consequence of the extreme differences in availability of teaching and learning facilities between schools and/or districts.

Thirdly, eventhough the phenomenon of misconception is commonly found in students and teachers, but this study clearly revealed that misconception in rural area is more frequently be ditected than that in urban and suburban areas. This finding of study justified more clearly the presence of critical shortage in learning facilities in rural area which are normally can be used by both students and teachers to up-grade their own knowledges. Even, in developed countries with homogenous etnicity and facility at the level of needed, students' and/or teachers' misconception on learning materials can be found. In these countries, the knowledge of teachers are refreshed or up-graded regularly, at least in the annual basis. For example, misconception on various physiological processes among the teachers have been reported in a high frequency (Driver, 1987).

Study also indicates that no area of study is totally free from misconception, both for teachers and students. It is also found that the frequency of students (and teachers) and the number of biology materials misconceptized by students (and teachers) are increased from urban an suburban to rural areas. This finding may also be viewed as a consequence of the lack of teachers' capability in enriching their modes of teaching in the classrom. Teachers in rural area are rarely up-graded, both in their subject matter, modes of evalutaion, and teaching methods or meodels. Because of traditional modes of instructional delivery and assessment may not reveal misconceptions then it is important that the preservice teachers dibekali dengan berbagai metode atau model pembelajaran khusus. For example, the drawing, writing, and mainly oral debate protocols expose student thinking as they present their evidence and

construct explanations, maybe suitable. Therefore, to produce competent and effective science teachers, the science education courses should be overhauled so that prospective science teachers will teach the school level science topics correctly. The science methods have a leading role to play in this regard to improve science teaching. This can be done during the science methodology courses of prospective and practicing science teachers.

CONCLUSION

In conclusion, misconception is a general problems both in students and biology teachers in North Sumatera. No schools or area of study is totally free from misconception, both for teachers and students. It is also found that the frequency of students (and teachers) and the number of biology materials misconceptized by students (and teachers) are increased from urban an suburban to rural areas.

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