Analysis of Genetic Misconceptions Student Biology Education at STKIP Persada Khatulistiwa Sintang

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Abstract: During the learning process of genetic course, students were difficult to assess the material because of its abstraction. Genetics materials contained technical terms that cannot be memorized and pronounced easily by the students. Its concepts were hard to be understood because it does not provide a conceptual framework. Students were not deconstructed and construct the genetic knowledge by using their critical thinking and logical reasoning; it was make the concept of genetic were not understood correctly. Some of the wrong exist concepts about genetic are the students tried to keep concepts confidently that they have gotten when study in the previous level of education by reading and materials has taught in the school, it was said as misconceptions. The student's misconceptions could be transferred to their students when they teach their students in the future. This is a qualitative research; it aimed to reveal the students genetic misconceptions. The samples of the research are 25 students in the 6th semester of biology education study program at STKIP Persada Khatulistiwa Sintang. The result of the research found that students misconceptions include the scope of genetic, genetic material, genetics of mendel, chromosome mutation, DNA manipulation, determination of sex and allelic, and genetics population and evolution.

Keywords: misconceptions, genetics, and biology students.

Students before take formal learning of biology in college already brought initial concept of biology. The initial concept they carry it sometimes inappropriate or contrary to the accepted concept of experts. A different concept that is often called the misconception or alternative concepts. The initial concept, they get while in elementary school, middle school, from their experiences and observations in the community or in everyday life (Berg, 2004). The misconception is also called preconceived ideas, non-scientific belief, naive theories, conceptions or misconceptions conceptual. (Heather, 2003).

According to Widha (2009) the results of the various countries showed that misconceptions experienced by students due to lack of proper application and use media that cannot illustrate the concepts learned. Another opinion explained that the misconception is affected by the process of the formation of knowledge in the minds of students.

Shaw et al (2008) revealed misconceptions of high school students through an essay contest to uncover misconceptions genetic material content. Genetics is one of the biological materials that are considered difficult. Based on the research results of a survey it is conducted by the writer on students of Biology Education at STKIP Persada Khatulistiwa Sintang known that many genetic content has not be understood by students and there are some misconceptions that have always defended the truth (misconceptions). According to Venville, (2002) the genetic material is felt hard by most students because this material is abstract and remote from everyday life. Students assume learning of genetics laborious and tedious. Students are not able to construct genetics as a whole as well as students are not able to connect between concepts of genetics. it leads to misconceptions.

The level of student understanding of the concepts of genetics will affect the level of understanding of the concept of truth and the delivery of genetics further the concept to the next students. Chattopadhyay (2004) reveals the difficulty of understanding the genetics survive in school or college. This is due to genetics are abstract because so elusive concepts.

The concept of genetics is different from the concept of genetic previously understood. Old understanding, genetics strongly associated with a decrease in properties. The next development genetics is the study of genes and their expression. A new understanding of genetics is the study of genetic material associated structure, reproduction, expression, amendments there to, their presence in the population, and its engineering (Corebima, 2009).

From the above background it can be formulated a research problem: What misconceptions genetic material found on the student of Biology education at STKIP Persada Khatulistiwa Sintang? The purpose of the research is to uncover the genetic material misconceptions among students of Biology education at STKIP Persada Khatulistiwa Sintang.

METHOD

This research was conducted in October to December in 2015. The research is a qualitative descriptive study aimed to reveal the genetic misconceptions in the 6th semester students of Biology Education at STKIP Persada Khatulistiwa Sintang. The samples of the research are 25 students. The instrument consists of 30 questions in the form of essays that contains misconceptions found in the study includes the scope of genetics, genetic material, genetics of Mendel, chromosome mutation, DNA manipulation, determination of sex and allelic, and population genetics and evolution. The instruments were distributed to students in the 6th semester of Biology Education at STKIP Persada Khatulistiwa Sintang. The data were analyzed descriptively to obtain a picture of the genetics on the student misconceptions.

RESULTS AND DISCUSSION

Students misconceptions experienced can occur because of misinterpretation of natural phenomena or events that encountered in their life. Misconceptions that students have been obtained at school are still settling on him until he is in college. Misconception usually develops as a learning process. Students experienced student misconceptions can mislead students in understanding scientific phenomena and conduct scientific explanation. If students do not realize the misconceptions, there will be confusion and incoherence on himself. In the end, if not immediately corrected, the misconceptions will be an obstacle for students in the learning process further.

Scope of Genetics

In general, students got a misunderstanding on genetics or scope of genetics. There are 95% of the students understand the genetics or the understanding of genetics as the study of crossing Mendel. But experts revealed that genetics is the study of heredity (inheritance) / genetic substance. Besides genetics they will learn about the genetics of Mendel, the genetic material (DNA, RNA, allele, chromosome, gene, protein synthesis), the structure of the process of formation and transmission of genes and gene expression mechanisms in controlling the nature of an organism, determination of sex and origin of sex, crossovers, chromosome mutations, microbial genetics, DNA manipulation and genetics population and evolution. According to Corebima (2010) Genetic understood as the study of the genetic material, which includes reproduction of genetic material, or the expression of genetic material work, alteration

of genetic material, the presence of genetic material in the population, and the engineering of genetic material. So in total investigated the genetic material. The overall concept of genetics must be understood in a coherent and should not be cut, so that the concept is fully organized and able to give meaning to the science of genetics is intact as well, that of genetic material.

Genetic Material

College students have misconceptions on genetic material of DNA and RNA. In general, college students have misconceptions about the function of DNA and RNA. There was also 80% college students have misconceptions whether the genes in the chromosome or chromosomes are in the genes, their tendencies reveal that chromosomes are in the genes. According W Johansen gene is the smallest unit of a living creature that contains the substance of heredity contained in the gene loci, while the chromosome by Suryo are objects smoother contained in the cell nucleus (nucleus) in the form of a straight or bent and consist of substances easily absorb the dye.

Lodish, et al (2007) revealed that the gene is the entire sequence of amino acid important in the synthesis of functional products in the form of RNA by transcription, and then translated to produce the polypeptide. The process of transcription produces RNA consisting of exons, a control area, and introns. On the concept further, the genes also have Tata box and enhancers. Besides that, college students have misconceptions understanding of homologous chromosomes, where 90% of the students understand that the homologue is chromosomes which has the same shape and size, is actually homologue chromosomes containing genes one allele and will be parallel on the metaphase stage during meiosis.

Autosomal chromosomes understood as chromosomes that are in the cells of the body (for example, skin cells) while the chromosome gonosom are in the sex cells (ie sperm and ovum in mammals). This understanding does not correspond to reality because the two chromosomes is present in all body cells and sex cells, both individual male and female individuals. According Corebima (1997) is an autosomal chromosome soma chromosome that expresses certain qualities and there are in all individuals both male and female. While chromosomes are existenced gonosom distinguish individual males and females. Dikmenli (2011) revealed that the student teachers are alternative conceptions or misconceptions about genes, DNA and chromosomes. The student also has difficulty connecting genetic material that has been studied first at the molecular level.

Genetics of Mendel

The research found that student in general (85%) understands about Mendel's laws only on the intersection of peas while other individuals that reproduce sexually through with Mendel's laws. The results showed that the students generally cannot distinguish Mendel's laws I and II. Students understand if the laws of Mendel I only learn about monohybrid cross II while Mendel's laws only learn about dihydric cross. Should be understood that in all good crosses monohybrid, dihydric, and polihibrid or crossbreeding with many different properties always occur Mendel's laws I and II.

According to Sugiharto (2008) law of Mendel I should be understood as the separation of genes the same allele freely during meiosis gamete cell formation. It is easily observed in monohybrid cross, but that does not mean the law is only happening on monohybrid cross alone. Mendel's Law II often known as free assorts law should be understood as events incorporation of genes that do not one allele there by completing the genetic information in a cell gametes. According Suparno (2005) the incompleteness of the information received by the students

caused by the students themselves to be one of the causes of misconceptions. Reasoning that one also happens to matter determines the ratio of crossbred Mendel wrong interpreted as a 'number of offspring' is produced is not a 'possibility'. Corebima (1997b) revealed that during the experiments, strains were crossed by J. G. Mendel to obtain second generation (F2). The characteristics that appear recorded the frequency so that the proportion of these traits can be revealed. The efforts eventually allow the identification of the legal separation of the free and the free choice of law. The moment of legal separation of the free and the free choice of law known as Mendel's laws I and II.

Chromosomal Mutation

In general (90%) students understand that the mutation is a disease caused by a virus or bacteria and can cause genetic changes that can be passed on to offspring. Actually, it is understood that the presence of mutant genes, the population will be high heterozygosity. Mutants will evolve, mutants that match its environment be adaptive. Mutants that do not match will be extinct. The species containing the mutant gene weak are eliminated and replaced with the mutant gene species suitable. According Warianto (2011) mutations are changes in the genetic material of an organism that occurs suddenly, random, and are the basis for living organisms' source of variation that is inherited (heritable). Mutations can also be interpreted as a change in the composition of the genome of a structural or bodies that may occur due to external factors (mutagens) or due to replication errors.

Many students understand if gene changes then also change the nature of a living creature. Of course the statement is not appropriate because of changes in the genes is not always followed by changes in the nature of living things. The term includes changes in the genetic mutation or recombination. Changes in the gene in genetics called gene mutation. There are two terms that neutral mutations and mutations silent mutations. Neutral mutation is a change of base pairs associated with the occurrence of a change in the genetic code, and can cause amino acid changes associated, but not to lead to changes in protein function (Russel, 1992 in Corebima, 2000); Silent mutations is a type of neutral mutations who undergo a change of base pairs in the gene that cause changes in the genetic code, but does not result in a change / change of amino acid encoded. In this case both the genetic code and the genetic code of the original mutant alike encode the same amino acid (Russel, 1992 in Corebima, 2000).

DNA manipulation

About responding on DNA technology, 85% of the students considered that it is a DNA recombination between DNA combine with each other to produce new DNA. It is certainly wrong because recombinant DNA is recombinant DNA techniques or genetic engineering to produce new properties by means of a specific gene recombination with genomic DNA. Recombinant DNA techniques are a collection intended for recombining genes in a test tube. Recombinant DNA techniques include isolation of DNA, DNA cutting techniques, DNA merge techniques and techniques to insert DNA into living cells.

Students responded (90%) that the transfer of DNA from one bacterium to another bacterium can only be done with the division; this certainly is wrong because the process of transfer of DNA from one bacterium to another bacterium can be done in three ways: conjugation, transformation and transduction. DNA into the bacterial cells can then be integrated with chromosomal DNA or recombinant bacteria to form chromosomes. Conjugation is the transfer of DNA from one cell (donor cell) into the bacterial cell (cell reserpine) through physical contact between the two cells. Transformation is a collection of DNA by bacteria from

the environment around him. DNA to be around bacteria (foreign DNA) may be pieces of DNA or DNA fragment derived from another bacterial cell or organism to another. The influx of environmental DNA into bacterial cells can occur naturally. Transduction is how to transfer DNA from one cell into another cell through the intermediary of bacteriophages. Some types of viruses multiply in bacterial cells. Viruses that its host is a bacterium often called bacteriophage or phage. When a virus infects bacteria, phage inserts its DNA into bacterial cells. The DNA will then be replicated in a bacterial cell or integrates with the chromosome bacteria. Phage DNA is packaged when forming a new phage particles will carry most of its host bacterial DNA. Furthermore, if the phage infects another bacterium, the phage will insert DNA that contains most of the previous host cell DNA.

In general (80%) students understand that DNA recombination was helpful to get new varieties of course this misconception because DNA recombination can also be used for the production of vaccines, insulin, antibodies, Factor IX for hemophilia B, human growth hormone (HGH), erythropoietin (epo) to treat anemia, certain types of interferon's, several interleukins, parathyroid hormone, monoclonal antibodies, hepatitis B surface antigen for vaccination against hepatitis B virus, and C1 inhibitor (c1inh). The misconception according to Hasan (1999) happens to students when the level of confidence (certainty) high student to a concept which was considered wrong. Interpretation of situations by the students of the environment can be different from the scientific conception that interferes with student learning. The extent possible misconceptions eliminated in the process of conceptual change.

Cognitive development of students who are not in accordance with the concept being studied also can lead to misconceptions in students. Because another misconception comes from the students is limited reasoning and one student, the student's ability to capture and understand the concepts being studied, as well as the interest of students to learn the concepts being (Pure, 2013).

Determination of sex and allelic

In general, students have misconceptions on the concept of sex determination and allelic. Not only is the definition of an elusive but also the differences among them not well understood. According to Corebima (1997a) sexing is grouped on the concept of expression or genetic material work, which included the phenotypic expression sub concepts living beings. Classification of blood, if examined from their allelic caused by mutations that should belong to the concept of change in the genetic material, namely sub concepts mutation. Classification of blood is reviewed of the structure of the mutated gene should then be grouped on the concept of genetic material such as DNA sub concepts structure or the structure of genes.

Study of sex determination has been only discussed sex determination in eukaryotic groups that reproduce sexually. Studies need to be developed in the other group includes prokaryotic, eukaryotic (in eukaryotic plants, invertebrates and vertebrates). Sex determinant gene expression is a gene that could be in the sex chromosomes, the chromosomes of the body or both. So who is responsible for the phenotypic sex is the gene. Gender expression is unique to each group or cannot be applied to all groups of living things (Corebima, 2004).

In addition Corebima (2004) stated genders in prokaryotes such as *e. coli* males and females are known from the factor F or HFR. In Chlamydomonas was known Invertebrates gender valence properties virility and female. Gender in the earthworm was known helix hermaphrodite. Gender in fly Drosophila melanogaster was known male, female, male super, intersex and female super because the balance of chromosomes. Gender vertebrate animals for example pisces quite varied there are hermaphrodites, gonochoristic sexology type, the type of

sex chromosomal expression. Gender in humans was known as male, female, female super to male super due to a change in chromosomes fail to separate as a result.

Population Genetics and Evolution

Students in general (85%) responded that population genetics is the study of the genetics of a population living creature. Of course this is wrong because of population genetics is a field of biology that studies the genetic composition of a population biology, and changes in the genetic composition resulting from the influence of various factors, including natural selection. Population genetics is closely tied to the study of evolution and natural selection, and is often regarded as the theoretical basis of modern Darwinism. Because of natural selection is one of the most important factors that could affect the genetic composition of a population.

In answering the question in general, the students answered a living creature must adapt to the environment in order to survive and not conflict with other living beings. It is certainly wrong should be understood that living things according to their environment will survive. If his condition does not fit or do not have the ability to adapt to the environment it will be extinct creatures. Tekkaya (2002) suggested that teachers at the school one of the causes of misconceptions which greatly affect the student's conception further.

CONCLUSION

The concept of genetics is still not properly understood by the students of Biology Education at STKIP Persada Khatulistiwa Sintang. There are several concepts that are found miskonsepsinya namely; the scope of which includes the understanding of genetics, genetic material which includes DNA, RNA, genes, chromosomes, homologous chromosomes, autosomal chromosomes and chromosome gonosom. Genetics of Mendel which is including of understanding genetics of Mendel, Mendel I and Mendel II, monohybrid, dihybrid and polihibrid. Chromosome mutation which includes: the definition of mutations and mutations cause itself. Manipulation of DNA that includes the definition of DNA recombination, DNA transfer and DNA recombination benefits: determination of sex and allelic: population genetics and evolution include: definition of population genetics, lifestyle and maintain their offspring.

Suggestion

Necessary to study the causes of misconceptions in high school students and students in universities, as well as the need to conduct research experiments to correct misconceptions that often occurs in Schools and Universities.

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