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THE RELATIONSHIP BETWEEN TYPES OF MISCONCEPTIONS AND ACHIEVEMENT IN GENETICS AMONG SENIOR SECONDARY SCHOOL BIOLOGY STUDENTS IN JOS NORTH LGA OF PLATEAU STATE

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ABSTRACT: *This research work was aimed at finding out the relationship between types of misconceptions and achievement in genetics among senior secondary schools biology students' in Jos-North Local Government Area of Plateau State. Correlation research as well as survey research designs were employed for this study. Three research questions and one hypothesis guided the study. The research was analyzed using frequency counts, percentages, mean and standard deviation while the hypothesis was analyzed using Pearson's r. The population of the study consisted of randomly selected biology teachers and students' of Government Senior Secondary Schools in the area of study. Thus, a total of two hundred and ten (210) respondents' were used. Two hundred students and ten teachers drown from ten schools served as sample for the study. Three instruments were used for data collection. Achievement Test in Genetics (ATG), Questionnaire on Types of Misconceptions (QTM) and Biology Teachers' Questionnaire on Students' Causes of Misconceptions in Genetics. Major findings from this research work revealed that, there is poor trend of students' academic achievement in genetics test, students' held vary form of misconceptions in genetics concepts and the most prevalent misconception found among the students' was the vernacular misconception, abstractness (AC), was the major reason for students' causes of misconceptions, and there is perfect negative relationship between students types of misconceptions and their achievement. Recommendations were made based on these findings. Some of these recommendations are; effective and evidence-informed pedagogic practices are clearly needed by all teachers, and students, to identify, overcome and eliminate misconceptions in the acquisition of accurate scientific knowledge, to promote effective and meaningful learning, teachers' need to identify the causes of such misconceptions and find ways to rectify them. The Government on her part should brace up to her responsibility of providing adequate teaching aids and instructional materials to all her schools, which must be equally use by the biology teachers to stimulate students in learning genetics.*

KEYWORDS: Education, Types of Misconceptions, Genetics, Senior Secondary School, Biology Students, Nigeria

INTRODUCTION

Science provides a body of knowledge for use in addressing various forms of human, material and environmental problems. Samantha (2015) opined that science can also be viewed as

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composed of two major complementary modes: accumulation of knowledge through exploration and discovery efforts about the natural world, and the use of such knowledge for human and material development.

The achievement of this can start with the learning and application of science subjects as in biology, chemistry, integrated science, and physics at secondary school level. Among these science subjects: biology, chemistry, integrated science and physics taught in Nigerian secondary schools, only biology is discussed. This is because the study focused on biology as well as genetic as a concept.

Adimweruka, and Okoronkwo, (2005) view biology as an integral science subject which provides contents in the training of students who want to study medicine, nursing, pharmacy, forestry, and fisheries. Genetics is one of the concepts studied in biology, according to Bridget (2016), the study of genetics can be intellectually fascinating, but it also has plenty of practical applications. From the use of DNA in court cases to the discovery of new therapies for genetic diseases, a thorough understanding of the human genome can have important medical, social and legal impacts. The rapid advances in genetic research, the popularity of the topic and the direct role that genetics plays in human health and reproduction make it a scientific discipline that everyone needs to understand. Yet, several studies reveal that students fail to critically understand the genetics knowledge taught in the classroom. This lack of understanding translates to an inability to apply basic knowledge to their everyday lives, (Lewis & Wood-Robinson 2000, Lewis and Kattmann 2004).

Many concepts in biology including genetics can be perceived as difficult to learn by high school students and this negatively affects their performances, (Tekkaya, Ozlem, and Sungur, 2001). A study by Mbajiorgu, Ezechi, and Idoko, (2006) revealed that science is a difficult subject to understand and grasp. Regardless of age, culture, and education background, as many students carry their own understanding of science, genetics is not an exception in this matter. Genetics is a very broad and complicated concept. Significant advances in genetics in recent decades have dramatically increased the impact of genetic information and technologies on society. Genetic issues now play a large role in health and public policy, (Miller 1998; Kolsto 2001). In spite of this increased exposure to genetics, recent studies of the general public's genetics knowledge show a relatively low understanding of genetics concepts, (Human Genetics Commission 2001; Bates 2005).

Lewis and Kattmann (2004) also stated that genetics is considered to be one of the most difficult concepts in biology and the mechanisms are hard to understand because it is difficult to make the ideas to be tangible without the help of special instruments. The study further revealed that students come to the classroom with their own conceptions of genetics from their own experience and observations. The uses of the words genes, DNA, chromosomes, are interchanged in trying to explain how traits are passed from one generation to the next.

Study by Lewis and Kattmann, (2004) revealed that students come to the classroom with their own conceptions (prior knowledge) of genetics from their own experience and observations and it is important to know students' misconceptions, presuppositions, and prior knowledge in Genetics. If teachers are not aware of these misconceptions, it creates a barrier that leads to confusion and incoherence, (Lewis and Kattmann, 2004).

Yenilmez, and Tekkaya, (2006) studied the misconception possessed by 9th grade students relating to cell division and the effects of the conceptual teaching regarding elimination of such

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conceptions. They hypothesized that conceptual teaching is an effective method for understanding the concepts related to cell division and for elimination of misconceptions. Lewis (2000) studied the students' level of understanding with regards to mitosis, meiosis and fertilization. Students possess inadequate knowledge and numerous misconceptions related to the physical relationships between the genetic material and the chromosomes and the relationships between the behavior of the chromosomes and continuity of the genetic information. Lewis (2000) further emphasized the fact that the students mainly experience difficulties for explaining the relationships between the chromosome and gene concepts and the similarities and differences between mitosis and meiosis.

Not only should the teachers be aware of these misconceptions, but also the students. When students recognize these ideas, being able to change or enhance them will be easier. Students might be able to make the connections themselves. Being able to discuss their ideas can help breakdown what is wrong and right about the misconceptions. The students can actively construct and reconstruct their knowledge with the discussions, (Mbajiorgu, Ezechi, and Idoko 2006). Teachers need to accept that these presuppositions are present and they need to use it towards their advantage and the prior knowledge of the students does have a basis which needs to be clarified.

Teachers should not be discouraged in teaching Genetics, but rather use the prior knowledge of their students. It is important because students need to be able to understand the basics of Genetics in order to be literate in growing technology of science. Genes are not just this cultural idea, but a powerful scientific idea. Students will need to be science literate citizens so that they may understand their health in the present and in the future, (Venville, Gribble, & Donovan, 2004).

CONCEPT OF MISCONCEPTIONS

Beginning with the work of Asubel in the 1920s to the present time, enormous studies have been done on science education focusing on identifying, analyzing, understanding and mapping the concepts students held before and after instruction (Wanderse, Mintzes, & Novak, 1994).

Learning science is a cumulative process and when new piece of information is added to what students' already know (or believe) about the topic at hand. If students have a solid foundation, the new pieces fit together more easily. However, if the students' preparation is incomplete, they may find it harder to grasp the new material. If the new material conflicts with earlier information or firmly held assumptions, the students unfortunately may ignore or distort the new information so that it fits into their old framework of understanding, (The National Academy Press 2016).

According to constructivist theory of learning, knowledge is uniquely constructed by each individual learner and learners actively construct knowledge to make sense of the world, interpreting new information in terms of existing cognitive structure. The particular knowledge that is constructed by an individual will be affected learners prior knowledge and experience and the social context in which learning take place, (Grayson 2001; Haluk, 2004).

According to Erol, Salih, and Erdem, (2012), if new concept were compatible with previous concepts, meaningful learning would occur, therefore it is important to know what prior knowledge students' bring to a learning environment in order to help them construct new

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knowledge. When teachers' provide instruction on concepts in various subjects, they are teaching students who already have some pre-instructional knowledge about the topic. Students' knowledge, however, can be erroneous, illogical or misinformed. These erroneous understandings are termed alternative conceptions or misconceptions, (or intuitive theories) (Burgoon, Heddle, & Duran, 2010).

In view of these, various studies have shown that children of all ages across the world have alternative conceptions of natural phenomena which they bring to science class. Such global studies have shown that students have misconceptions or alternative conceptions in all of science subjects and other related science disciplines as reported by Gooding & Metz, (2011); Lee and Law (2001); Palmer (2001);Nicoll, (2001); Tekkaya (2002).

In broad terms, misconceptions correspond to the concepts that have peculiar interpretations and meanings in students' articulations that are not scientifically accurate. In the literature, misconceptions are also referred to as naive beliefs, (Caramazza, McCloskey & Green, 1981), erroneous ideas (Fisher, 1985), preconceptions (Hashweh, 1988), alternative frameworks, (Driver & Easley, 1978). Although the term misconception is dominant in the literature, some researchers like Abimbola (1988); Gilbert & Swift (1985); Wandersee, Mintzes and Novak (1994) prefer the term alternative conception. It is important to use the term misconception rather than the alternatives in order not to create a concept-confusion because of the following reasons: it is still commonly used by many researchers, the term already has familiarity in the public, and it easily conveys the message that a concept might have contradictory connotations with the current scientific thought in science education.

According to Kelley (2012), the preexisting ideas held by students that are contrary to modern scientific thinking about the natural world are generally referred to as misconceptions. Today, there is tremendous interest among practitioners in learning how to use various tools and techniques to elicit students' misconceptions in science. All misconceptions are major barriers to learning, students do not come to the classroom as blank slates according to constructivist theory and that when new ideas are encountered, and they are either accepted, rejected, or modified to fit existing conceptions. It is a cognitive dissonance students experience when they realize an existing mental model no longer works for them that make students willing to give up a preexisting idea in favor of a scientific one.

Children assemble their own thoughts about how the world works and elucidate scientific phenomena in terms of these thoughts. These kinds of thoughts or ideas are referred to as misconceptions, (Nicoll 2001). The word misconception is frequently used to describe all ideas students bring to their learning that are not completely accurate. It is important to understand that the word misconception is a general way of lumping together students' scientifically inaccurate or partially accurate ideas. All misconceptions are major barriers to learning. Keeley (2008) explained that replacing these misconceptions with accurate scientific knowledge could be difficult. Haluk (2001) viewed that the term misconception means any concept that differs from the commonly accepted scientific understanding of the term. Palmer (2001) revealed that research has shown that children bring to lesson a lot of preexisting (misconceptions) conceptions about scientific phenomena that can interfere with students learning of correct scientific principles or concepts. Taber (2000) believes that misconceptions may arise as a result of the variety of contacts students make with the physical and social world or as a result of personal experience, interaction with teachers, other people, or through the media.

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Sometimes misconceptions are formed from a student's past experiences, sometimes from incorrect past teaching; often the cause cannot be identified. Theory tells us and it is borne out in the evidence from the studies we've analyzed that in the absence of complete and accurate schema, students will inductively assemble the various pieces they have in whatever whole conception seems to fit all of the data at hand.

In Nigeria, studies of students' misconceptions or alternative conceptions in science started in the early 1980's by Olakanmi (1986), Okebukola (1986) and Ivowi (1983). Also there are recent studies in Nigeria about students' misconceptions such as;

Olakanmi (1986) investigated the level of alternative conceptions of human respiration held by selected form four students in Nigeria and found out that there was a significant relationship between students' alternative conceptions and their performance. He attributed students' poor understanding of human respiration concepts because of students' alternative conceptions are usually characterized by low frequencies because of the idiosyncratic nature of students' conceptions, shortage of human and materials resources in schools. He then argued that if biology teachers have difficulties understanding and teaching respiration concepts, it means that they cannot foster a good understanding in their students.

Nakhleh (1992) defines misconception as concepts which students construct on their own but these are outside the concepts which are scientifically accepted or are aimed to be constructed by teachers. Main reasons for misconception are faulty or insufficient perception of the concepts learnt, concepts of daily language having different meanings in scientific language, not using appropriate teaching approaches while teaching topics and concepts, insufficiency in the construction of relationships between the concepts and concepts and daily life, (Mann and Treagust, 1998). The big issues are that once a misconception has been formed it is extremely difficult to change, (Eggen and Kauchak, 2004) and that possessing misconception can have serious impacts on learning, (Hanuscin, 2005). Students come into the classroom with prerequisite knowledge or existing schemas and as they progress through their education these schemas are progressively or sequentially built upon, (Alagumalai, 2005). It seems obvious that teachers need to understand the content they are trying to convey to students. But a new study finds that what's especially critical to improved science learning is that teachers also know the common misconceptions students have. And in science, there are plenty of things that young people and a lot of adults don't correctly understand, such as what causes the change of seasons.

Types of Misconceptions

Misconceptions (alternative conceptions, alternative frameworks) are a key issue from constructivism in science education, a major theoretical perspective informing science teaching. In general, scientific misconceptions have their foundations in a few intuitive knowledge domains, (Barker 2004). Much research in science education in now being focused on students' alternative conceptions about science following the discoveries by teachers that despite their efforts, students' do not grasp fundamental ideas covered in class in science subjects like biology (genetics). From Wikipedia, (2012) revealed that misconceptions can be broken down into five basic categories.

- Preconceived notions; are popular conceptions rooted in everyday experiences. For example, many people believe that water flowing underground must flow in streams because the water they see at the earth's surface flows in streams. Preconceived notions

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plague students' views of heat, energy, and gravity, (Brown and Clement, 1991), among others.

- Nonscientific beliefs; include views learned by students from sources other than scientific education, such as religious or mythical teachings. For example, some students have learned through religious instruction about an abbreviated history of the earth and its life forms. The disparity between this widely held belief and the scientific evidence for a far more extended pre-history has led to considerable controversy in the teaching of science.

- Conceptual misunderstandings; arise when students are taught scientific information in a way that does not provoke them to confront paradoxes and conflicts resulting from their own preconceived notions and nonscientific beliefs. To deal with their confusion, students construct faulty models that usually are so weak that the students themselves are insecure about the concepts.

- Vernacular misconceptions; arise from the use of words that mean one thing in everyday life and another in a scientific context (e.g., "work"). A geology professor noted that students have difficulty with the idea that glaciers retreat, because they picture the glacier stopping, turning around, and moving in the opposite direction. Substitution of the word "melt" for "retreat" helps reinforce the correct interpretation that the front end of the glacier simply melts faster than the ice advances.

- Factual misconceptions; are falsities often learned at an early age and retained unchallenged into adulthood. If you think about it, the idea that "lightning never strikes twice in the same place" is clearly nonsense, but that notion may be buried somewhere in your belief system.

Statement of the problem

The problem of this research revolves around the report of the chief examiners' for the biology theory paper which indicates that candidates had difficulties in answering questions on genetics. For example, the chief examiners' report of WAEC 2013 stated that majority of candidates seemed not to know genetics terminologies and also lack understanding of the usage of genetic symbols, present the allele for dominance first to be followed by allele for recessive in the genotypes write-ups i.e. *Rr* and not *rR*. The complementary base pairs in DNA structure were poorly known, many candidates did not understand that human sex-determination is governed by the XX and XY chromosome pairs. There was a noticeable majority of candidates who were unable to list even two common sex linked characteristics in humans.

Thus, as a result of these misconceptions in relation to candidates inability understand genetic terminologies and genetic symbols, they are not able to answer the examination questions which has contributed to poor performance in biology as contained in the WAEC external examiners report. This study seeks to address this challenge on the part of the students.

Research Questions

In order to guide the researcher in his investigation of the problems, the following research questions have been formulated;

1. What is the level of students' achievement in genetic?

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2. What types of misconceptions do students' have among senior secondary students' about genetic concepts?

3. What are the causes of misconceptions?

Hypothesis

1. There is no significant relationship between types of misconceptions and achievement in genetic.

Research Design

In order to arrive at the desired result from a study that seeks to find out the relationship between level of students' types of misconceptions and achievement in genetics among senior secondary schools of biology students' in Jos North LGA of Plateau State, two research designs were used for this study namely: correlational research design and survey research design. These research methods are suitable for this study because types of misconceptions and achievement are the key variables of this study.

Population and Sample

Population

This refers to the target group the researcher is interested in studying and about which information will be obtained from so as to draw inferences. Consequently, the population of the study was restricted to all SSS III Biology students of Government Senior Secondary Schools (GSSS) in Jos-North Local Government Area of Plateau State. The total number of SSS III students in public secondary schools in Jos-North is 1,853 while the number of biology teachers is 46. There are twenty three registered and approved public senior secondary schools in Jos-North Area Directorate of Education (Ministry of Education). Out of the twenty three registered and approved public schools in the study area, ten schools were randomly selected to obtain the sample population out of the twenty three schools.

Sample

The overall sample used for the study is two hundred and ten respondents comprising of twenty biology students from each of the ten selected schools totaling two hundred students and one biology teacher from the same selected schools, totaling ten teachers. This gives us an overall sample population of two hundred and ten respondents comprising two hundred students and ten teachers respectively.

Data Collection Tool

Basically, three instruments were use in collecting data for this study. They are; Achievement Test in Genetics (ATG), Questionnaire on Types of Misconceptions (QTM) and biology teachers' questionnaire on students' causes of students' misconceptions in genetics concepts respectively.

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DESCRIPTION OF THE INSTRUMENTS

Achievement Test on Genetics (ATG)

This instrument was constructed by the researcher to assess students' understanding of genetics concepts. Questions used in this test were directly derived from validated WAEC multiple choice questions in genetics. The objectives of the test were to access students' understanding of genetics concepts.

Questionnaire on Types of Misconceptions on Genetics (QTM)

This consists of the topics that students might have not been able to answer correctly while answering the questions on achievement test on genetics. These topics were rated on five reasons given by students for not given correct answers to topics base on students' everyday experience, their use of view from religious and mythical teaching, their understanding from what they learned from textbook, their understanding from what their teacher taught them and what they learned as children. Students were required to tick any one of the five reasons that best reflects their understanding of the concepts in genetics.

Questionnaire on Students' Causes of Misconceptions on Genetics (For Biology teachers')

This consist a search of related literature that reveals textbooks, abstractness, teachers and teaching methods, language problem, oversimplifications, students' attitude toward biology, topic not taught by teachers. Incorrect diagrams and analogies and cultural beliefs and practices are some of the principal sources of high school students' misconceptions of many science concepts including those in biology.

Validity and Reliability of the Instrument

Validity

The validity of the instruments was established by subjecting the instruments to the expert judgment and scrutiny by experts in the field of biology education in the department of science and technology in the faculty of Education University of Jos.

Reliability

This refers to the degree to which an assessment tool or measuring instrument produces stable and consistent results. It is therefore the consistency of measurement expressed as a correlation coefficient. To this end, in order to ensure reliability of the instruments, reliability coefficient of the instruments was computed using the Cronbach Alpha method of reliability to establish internal consistency of the instrument. In this case, the level of significance in which the instruments were adjudged reliable was at 0.07.

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FINDINGS

Research question one: What are the levels of student's achievement in the genetics concepts test?

Table 1: Students Performance in the Achievement Test in Genetics (ATG)

Class Interval Score	Frequency (F)	Cumulative Frequency (CF)	Percentage (C %)
41– 50	2	200	1 %
31– 40	13	198	6.5 %
21– 30	43	185	21.5 %
11 – 20	65	142	32.5 %
1 – 10	77	77	38.5 %
Total	**200**		**100%**

In order to ascertain the general level of student's achievement in genetics concepts, frequency count and cumulative percentage by class intervals were used to analyze the data. The results had shown on tables 2 and 3. The score range of 1 – 20 marks indicates a below average score while a score range of 21 – 30 marks show an average score and the score range of 31 – 50 marks indicate an above average score.

The result in table 1 shows that approximately 21.5 % of the students scored at or below marks while about 6.5 % scored 31 marks and above. This indicates that the trend of students' achievement on this genetics test is poor.

Table 2: Mean and Standard Deviations of Students Scores in Achievement Test in Genetics (ATG)

Number of Students	Total scores	Mean	Standard Deviation
200	**2999**	**14.9**	**10.6**

The result in table 2 shows a mean of 14.9 and standard deviation of 10.6. Therefore, a mean of 14.9 and standard deviation of 10.6 show that 1/3 of the response is between 4.3 (14.9 – 10.6) which is the lowest score and 25.5 (14.9 + 10.6) as the highest score. This then means that the students' responses were widely spread around the mean.

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Table 3: Achievement Scores of Students on the Achievement Test in Genetics

Class Interval Achievement Scores	Frequency of Achievement Scores	Percentages Scores At Each Class Interval
41– 50	2	1%
31 – 40	13	7%
21 – 30	43	22%
11– 20	65	31.5%
1 – 10	77	38.5%
Total	**200**	**100**

Table 3 reveals only 1% of the students scored between 41 – 50 out of 50 marks, while 7% of the students' scored between 31- 40 out of 50 marks, and 92% of the students' failed the test as 1- 30 marks. This then reveals a poor trend of students' achievement on genetics test.

Research Question Two: What types of misconceptions do senior secondary school students have about genetics concepts?

Table 4: Percentage of Students with Each Category on Type of Misconceptions

Types of Misconceptions	Number of Students With Misconceptions	Percentages of Students with Misconceptions
PCN	41	20.5%
NSB	34	17%
VM	63	31.5%
CM	38	19%
FM	24	12%
Total	**200**	**100%**

This consists of the topics that students might have not been able to answer correctly while answering the questions on achievement test on genetics. These topics were rated on five reasons given by students for not given correct answers to topics base on students' everyday experience (Preconceived Notion), their use of view from religious and mythical teaching (Non Scientific Belief), their understanding from what they learned from textbook (Vernacular Misconception), their understanding from what their teacher taught them (Conceptual Misunderstanding) and what they learned as children (Factual Misconceptions). Students were requiring ticking any one of the five reasons that best reflex their understanding of the concepts in genetics. These types of misconceptions were used as a bench- mark to find out from students' the type of misconceptions they hold about genetics concepts adapted from Mang (2015).

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The result from above table revealed that 41% of the students' were found to had preconceived notion type of misconception (PCN), and 17% of the students' had non-scientific belief (NSB) type of misconception, 31.5% of the students' exhibit vernacular misconception (VM) type of misconception, while 19% of the students' had conceptual misunderstanding (CM) and 12% of the students' had factual misconception (FM).

From this result the most prevalent misconception found among the students' was the vernacular misconception. This arises when students' use words that means one thing in everyday life and another in a scientific context.

Research Question Three: What are the causes of students' misconceptions on Genetics?

Table 5: Responses and Percentage of Students causes of misconceptions in Genetics Concepts

N/S	ATG Item with Misconceptions	Causes of Misconceptions								
		LP	AC	SAB	TTM	TNT	TB	CBP	ID	Total
1	Phenotypes	-	2	3	2	1	-	-	2	10
2	Genotypes	-	3	1	4	-	1	-	1	10
3	Chromosomes	1	4	-	4	1	-	-	-	10
4	Sex-determination	-	5	-	3	1	-	-	-	10
5	Genetic Crosses	1	3	1	-	1	-	-	4	10
6	Probability	-	4	2	-	-	-	-	4	10
7	Mendelian Law	1	9	-	-	-	-	-	-	10
8	Traits	-	5	1	1	-	2	-	1	10
9	Variations	2	2	1	1	2	1	1	-	10
10	Alleles	-	9	-	-	-	-	-	-	10
11	Structure of DNA	-	7	2	-	-	-	-	1	10
Column Total		**5**	**53**	**11**	**15**	**6**	**4**	**1**	**13**	**110**
Percentages		**4.5**	**48.2**	**10**	**13.6**	**5.5**	**3.6**	**1**	**11.8**	

This consist a search of related literature that reveals textbooks, abstractness, teachers and teaching methods, language problem, oversimplifications, students' attitude toward biology, , and incorrect diagrams and analogies and cultural beliefs and practices which are some of the principal sources of high school students' misconceptions of many science concepts including those in biology.

The result on table 6 reveals that abstractness (AC), was the major reason given by teachers' to be the students' causes of misconceptions and it has the highest percentage of 48.2 %.

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Hypothesis

There is no significant relationship between types of misconceptions and achievement in genetic.

Table 6: Item Analysis of types of misconceptions and students' achievement test in Genetics

Correlation

		Misconception	Achievement
Misconception	Pearson Correlation	1	-.244
	Sig. (2 tailed)		.693
	N	5	5
Achievement	Pearson Correlation	-.244	1
	Sig. (2tailed)	.063	
	N	5	5

Pearson product moment correlation coefficient was used to determine the strength and magnitude of the relationship between students' achievement and types of misconceptions at p> 0.07 level of significance.

The calculated correlation coefficient between students' types of misconceptions and achievement to be -.244 with a *p* level of 0.693 (2-tailed). Here, we could say the following: There is a statistically significant negative correlation between types of misconceptions and achievement (r = -.244, p < .05). In statistics, a perfect negative correlation is represented by the value -1.00. Negative correlation means that there is a perfect negative correlation, or relationship, between two variables. In this case, as misconceptions increases, the achievement decreases in exactly the same level or proportion. Also, as misconceptions decreases, achievement increase in exactly the same level or proportion.

DISCUSSION

This research work was on the relationship between types of misconceptions and achievement in genetics among senior secondary schools biology students in Jos-North LGA of Plateau State. It was with the purpose of providing useful strategies that will aid biology teachers on how to address misconceptions and types of misconceptions using pedagogical strategies that the students' find motivating and are also efficient and effective. As such, several research questions and hypotheses were set at the inception of this study.

Research question one revealed that the trend of students' achievement on genetics test was poor largely because of the students' level of misconceptions in genetics concepts. Findings in the present study were consistent with the findings of Olakanmi (1986) which states that there was a significant relationship between students' alternative conceptions and their performance. He attributed students' poor understanding of concepts because students' alternative conceptions are usually characterized by low frequencies due to the idiosyncratic nature of students' conceptions.

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Research question two discovered that the most prevalent misconception found among the students' was the vernacular misconception. This arises with students' use of words that means one thing in everyday life and another in a scientific context. Findings in the present study were consistent with the findings of Fatokun (2016) on the Instructional misconceptions of prospective chemistry teachers in chemical bonding that many of the participants had vernacular misunderstanding in most of the basic concepts.

Research question three showed that abstractness of genetics concepts (AC), was the major reason given by teachers' to be the students' causes of misconceptions and it had the highest percentage of 48.2 %. Findings in the present study were consistent with the findings of Tekkaya (2002) that misconceptions also arise when students combined newly learned concepts with their previously held more primitive concepts. Such situation creates conceptual conflict in the students' mind.

Conversely, the null hypothesis stated and tested showed there was a statistically significant negative correlation between types of misconceptions and achievement. As misconceptions increased, the achievement decreased in exactly the same level or proportion. Also, as misconceptions decreased, achievement increased in exactly the same level or proportion.

CONCLUSION

From the research conducted, this study revealed that many students had misconceptions about genetics concepts and ideas. Students were influenced by abstractness of the genetics concepts which definitely influenced the process of knowledge construction. To treat misconceptions effectively and to cope with vernacular misconceptions, it was discovered that it was necessary to have a clear understanding of their nature and origin. This study supported the view that students' misconceptions should be identified together with their reasons. Information about students' reasoning is important in terms of developing teaching strategies to remove or to minimize the likelihood of occurrence. Teaching and learning are not synonymous; we can teach and teach well without having the students learn. To promote concept building and remediate any misconceptions it is important to provide students with opportunities to verbalize their ideas.

Therefore, in teaching and learning of biology, concepts do not exist in isolation. Each concept is closely related to others and certain prerequisite concepts are necessary for a learner to develop understanding on a certain concept.

RECOMMENDATIONS

In the light of the above findings, the researcher wishes to make the following recommendations: Biology teachers should design their lesson based on students learning difficulties, educational curriculum designers while stakeholders need to design the educational materials including active learning methods of instruction in the syllabi, different instruments such as worksheets including graphic presentations; conceptual problems and conceptual assignments help improve the instruction of biology, Biological science curriculum should be designed on conceptual change approach instruction to minimize students' misunderstanding in biology, Teachers should be aware of students' misconceptions and their harm to learning

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when developing their instruction materials and planning their lesson, Effective and evidence-informed pedagogic practices are clearly needed by all teachers and students to identify, overcome and eliminate misconceptions in the acquisition of accurate scientific knowledge, New innovative techniques and models of science instruction must be practiced by teachers such as cooperative learning strategies, Inquiry training model etc, Students' motivation and interest should also be taken into consideration because there is a necessity for making the subject biology curriculum more contemporary, meaningful and interesting for the students, and Biology courses should be supported with qualified textbooks, instructional materials, laboratory sessions and observation and experiments that actively engage students in learning processes.

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APPENDIX A 1

NO	Name Of Schools	Number of Questionnaires Distributed to Students and teachers	Numbers of Questionnaires Returned	Percentages
1	GSS GWONG	21	21	10%
2	GSS LAMINGO	21	21	10%
3	GSS GANGARE	21	21	10%
4	GSS ANGWAN ROGO	21	21	10%
5	GSS RIKKOS	21	21	10%
6	GSS UTAN	21	21	10%
7	GSS LARANTO	21	21	10%
8	GSS NARAGUTA	21	21	10%
9	GSS KABONG	21	21	10%
10	GSS GWONG	21	21	10%
	TOTAL	**210**	**210**	**100%**

APPENDIX B 1

FIRST INSTRUMENT: ACHIEVEMENT TEST ON GENETICS (BIOLOGY)
Name (optional) _____
Sex_____
Name of school_____

Instruction: this paper contains twenty objectives test items on genetics. Answers all questions. Circle only the correct option please.

1. Characteristics that exhibit continuous variation are generally controlled by
   A. Single gene
   B. recessive gene
   C. Epistatic
   D. Multiple genes.

2. Difference in characteristics that exist among individual of the same species is referred to as
   A. Genetics
   B. Dominance
   C. Hybrid
   D. variation

3. Which of the following statement about chromosomes is correct?
   A. All the chromosomes of a species are the same in shape
   B. The number present in a species is constant
   C. They are neatly arranged in the cytoplasm
   D. The bear ribosomes on their outer membrane

4. Which of the following diseases can by inherited?
   A. Pneumonia

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B. AIDS
C. Sickle cell anemia
D. Goiter

5. In genetics, linkage refers to the linkage of genes of the
   A. Same chromosomes
   B. Different chromosomes
   C. Same nucleus
   D. Different nuclei
6. A man's blood group is AB. What is the probability of the man giving birth to a child with blood group O?
   A. 0%
   B. 25%
   C. 50%
   D. 100%

7. What name is given to sudden change in a gene or chromosome?
   A. Allele
   B. Genotype
   C. Mutation
   D. Phenotype

8. Acquired characters are
   A. Received from parents
   B. Passed to offspring
   C. Caused by the environment
   D. Caused by mutation

9. Fingerprints are useful in crime detection because
   A. The police have sophisticated fingerprint machines
   B. Thieves may leave their prints at the scene of the crime
   C. No two people have the same fingerprint
   D. Fingerprints are easy to make

10. In a family of eight all the children are girls. Which of the following reason correctly explain this
    A. The woman cannot produce male children
    B. The man has a low sperm count
    C. The Y component of the man's sex chromosome was always involved
    D. The X component of the man's sex chromosome was always involved.

11. Name of the phase in mitosis where the chromatids are located at opposite end of the cell
    A. Prophase
    B. Metaphase
    C. Anaphase
    D. Telophase

12. Why are there so many possible combinations of maternal and paternal traits in each generation of offspring?

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A. Because there are the same number of chromosomes in each cell
B. Because of the random grabbing of chromosomes by the microtubules during metaphase I
C. Because of the biological components that chromosomes are made of
D. Because of the high frequency of viral invasion.

13. A recessive allele t is responsible for a condition called distonia. A man who has this condition marries a woman who doesn't. One of their four children has the condition. What are the possible genotypes of the man and woman?
A. The father is Tt; the mother is TT
B. The father is tt; the mother is TT
C. Both parents are tt
D. The father is tt; the mother is Tt.

14. During meiosis, the chromatids become daughter chromosomes during which stage?
A. Prophase I
B. Metaphase II
C. Anaphase II
D. Telophase I

15. If a piece of DNA breaks off a chromosome and attaches itself to a non homologous chromosome at another location, what type of change has occurred?
A. Translocation
B. Duplication
C. Deletion
D. Inversion

16. Why is there no duplication of the DNA between meiosis I and meiosis II?
A. To produce genetically identical daughter cells
B. To increase genetic variability
C. To reduce the chromosome number to haploid in the resulting daughter cells
D. The chromosomes duplicate twice during meiosis I.

17. When you notice that someone has unusually blue eyes, you've noticed their
A. Phenotype
B. Allele.
C. Genotype.
D. Hybridization.

18. During metaphase mitosis chromosomes
A. Undergo coiling
B. Line up at the equator
C. Break and disintegrate
D. Undergo each other

19. Which of the following genotypes causes Klinefelter syndrome?
A. XO
B. XX
C. XXY

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D. XYY

20. Which of the following most contributes to a large variation of traits inherited by an offspring?
    A. Production of polar bodies
    B. A small gene pool
    C. Homozygous dominance
    D. Random shuffling of homologous chromosomes in gamete production

21. Which of the following would have the same base sequencing in their DNA?
    A. A male parent and his male offspring
    B. Siblings
    C. Identical twins
    D.A female parent and her offspring

22. The outward appearance of an organism is referred to as
    A. Phenotype
    B. Genotype
    C. Dominance
    D. Recessiveness

23. The observable characteristics of an individual usually resulting from the interaction between the gene composition and the environment is referred to as
    A. Allele
    B. Genotype
    C. Phenotype
    D. Dominance

24. Two tall plants were crossed; some of the offspring were tall and others short the possible genotype of the parents plants were
    A. TT and TT
    B. TT and tt
    C. Tt and Tt
    D. Tt and TT

25. The haploid number of chromosomes in human is
    A.48
    B. 46
    C. 24
    D. 23

26. Which of the humans' traits can be affected by environmental factors?
    A. Skin colour
    E. Eye colour
    C. Baldness
    D. Tongue-rolling

27. The important laws of hereditary were first stated by
    A. Darwin

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B. Mendel
C. Lamarck
D. Hopkins

28. Genetics is the branch of biology which deals with
A. Laws of hereditary and variation
B. Process of cell division at gametogenesis
C. Formation of new species through natural selection
D. None of the above

29. What does DNA stand for?
A. Dominant nuclear acid
B. Deoxyribonucleic acid
C. Daily nursing applejuice
D. Denominater of numerous alleles

30. Sister chromatids are joined together by
A. Centromeres
B. Centrosomes
C. Chromosomes
D. Chromameres

31. Mendels law of _____ stated that some allele are dominant over other alleles
A. Independent assortment
B. Dominance
C. Segregation
D. Recession

32. The crossing of F1 to homozygous recessive parent is called.
A. Back cross
B. Test cross
C. F1 cross
D. All of these

33. The test cross is used to determine the.
A. Genotype of the plant
B. Phenotype of the plant
C. Both A and B
D. None of these

34. Monohybrid test cross ratio is
A. 3:1
B. 2:1
C. 1:1
D. 9:3:3:1

35. The cross in which parents differ in two pairs of contrasting characters is called
A. Monohybrid cross

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B. Dihybrid cross
C. Trihybrid cross
D. Tetrahybrid cross

36. The phenotypic dihybrid ratio is
A. 9:3:2:1
B. 9:3:2:2
C. 1:1
D. 9:3:3:1

37. In MendelsDihybrid cross, the phenotypic ratio of F2 for a single character is
A. 9:3:2:1
B. 9:3:2:2
C. 3:1
D. 9:3:3:1

38. Which of the following statements is true regarding the law of independent assortment?
A. Factors assort independent of each other when more than one pair of characters are present together
B. Independent assortment leads to variation
C. Independent assortment leads to formation of new combinations of characters
D. All of these

39. The dihybrid test cross ratio is
A. 9:3:2:1
B. 9:3:2:2
C. 1:1:1:1
D. 9:3:3:1

40. Each gametes carry
A. Only recessive allele
B. Only dominant allele
C. Only one of the alleles
D. All of these

41. Which of the following terms represent a pair of contrasting characters?
A. Homozygous
B. Heterozygous
C. Allelomorphs
D. Co-dominant genes

42. The best method to determine the genotype of dominant parent is by crossing it with the hybrid.
This cross is called
A. Back cross
B. Test cross
C. Selfing
D. Cross fertilization

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43. The best method to determine the homozygosity and heterozygosity of an individual is
    A. Self- fertilization
    B. Back cross
    C. Test cross
    D. Inbreeding

44. All of this obeys Mendel's laws except
    A. Linkage
    B. Independent assortment
    C. Dominance
    D. Purity of gametes

45. The geometrical device that helps to find out all the possible combinations of male and female gametes is called
    A. Punnete square
    B. Bateson square
    C. Mendel square
    D. Morgan square

46. The title of Mendel's paper while presenting at Brunn Natural History Society in 1865 was
    A. Laws of inheritance
    B. Laws of heredity
    C. Experiments on pea plants
    D. Experiments in plant hybridization

47. What types of cell is created with mitosis?
    A. A haploid cell
    B. A sex cell
    C. Two new identical bodies
    D. All of the above

48. What types of cell is created with meiosis?
    A. A body cell
    B. A sex cell
    C. Four haploid cells
    D. None of the above

49. Which of the following is not a phase in mitosis?
    A. Prophase
    B. Metaphase
    C. Interphase
    D. Telophase

50. Pairs of sister chromatids that join together are called
    A. Groups
    B. Quarletes

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C. Tetrads
D. Bunches of chromatin

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APPENDIX B 2

SECOND INSTRUMENT: QUESTIONNAIRE ON STUDENTS' TYPES OF MISCONCEPTIONS ON GENETICS

Name (optional) _____

Sex_____

Name of school_____

Instruction: Students' are requested to give an honest response by ticking any of the reason below.

I give answer on the listed topics based on					
Topics	A What my teacher taught me	B What I learnt from books	C My everyday experience	D What I learnt as a child	E My use of views from religious and mythical teaching
Phenotypes					
Genotypes					
Chromosomes					
Sex-determination					
Mendelian Law					
Alleles					
Traits					
Variation					
Structure of DNA					
Genetic Crosses					
Mitosis and meiosis					
Probability					

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APPENDIX B 3

THIRD INSTRUMENT: QUESTIONNAIRE ON STUDENTS' CAUSES OF MISCONCEPTIONS ON GENETICS

Name (optional) _____

Sex_____

Name of school_____

Instruction: students' are requested to tick any of the rating scale in the appropriate column that best described causes of their misconceptions in genetics.

Causes of students' misconceptions									
S/N	**Topics**	**LP**	**AC**	**SAB**	**TTM**	**TNT**	**TB**	**CBP**	**ID**
1	Phenotypes								
2	Genotypes								
3	Chromosomes								
4	Sex-determination								
5	Probability								
6	Genetics Crosses								
7	Mendelian Law								
8	Alleles								
9	Traits								
10	Variation								
11	Structure of DNA								
12	Mitosis and Meiosis								

KEY

LP – Language Problem
AC – Abstractness of Concepts
SAB – Students' Attitude Toward Biology
TTM – Teacher/Teaching Method
TNT – Topic Not Taught By Teacher
TB – Textbooks
CBP – Culture Belief/Practices
ID – Incorrect diagrams

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