

CHAPTER 4.
DATA ANALYSIS

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First, second and third chapter include Introduction, Review of Related Literature and Methodology. This fourth chapter discusses the data analysis procedure of both Two-Tier Diagnostic Test and Interview schedule, followed by discussion.

4.1. Introduction

Data can be sometimes very reliable and valid but if not analyzed properly, the research is left with of no purpose at last. Hence the way data is analyzed and interpreted is very important. Present study, titled as “A Study of Alternative Conceptions in Biology among 12th Class Students” was carried out in Nuapada district of Odisha. The test used to diagnose alternative conception and its sources are Two Tier Diagnostic Test including unstructured interview schedule.

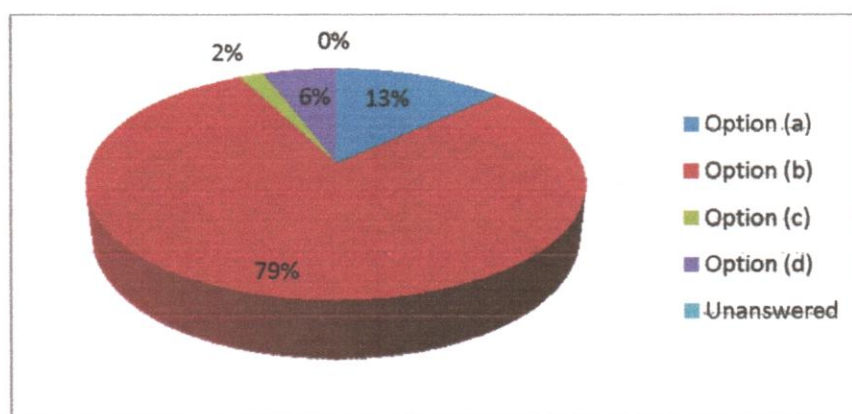
First the MCQ were analyzed on the basis of percentage of students giving the wrong answer. More the wrong answers, greater is the probability of alternative conception. The percentage of students chosen particular answers are represented in pie chart. It helps giving a visual representation of the total answers given by students and its probability for alternative conception. Once the major area of alternative conception are diagnosed *fulfilling the first objective*, the second part of Two Tier Diagnostic Test is analyzed i.e., reason given by students for choosing the particular answer after each MCQ. They are analyzed qualitatively, observing the reasons given in the second tier as this would be the basis for interview schedule later. Finally the interview schedule is discussed where the researcher tried to find out the major sources of alternative conception to fulfil *second objective of the study*.

4.2. Data analysis of two tier diagnostic test

Each of the questions of MCQ is stated and the answers given by students are analyzed. Percentage of students giving right answers are stated in sentence and represented using a pie chart.

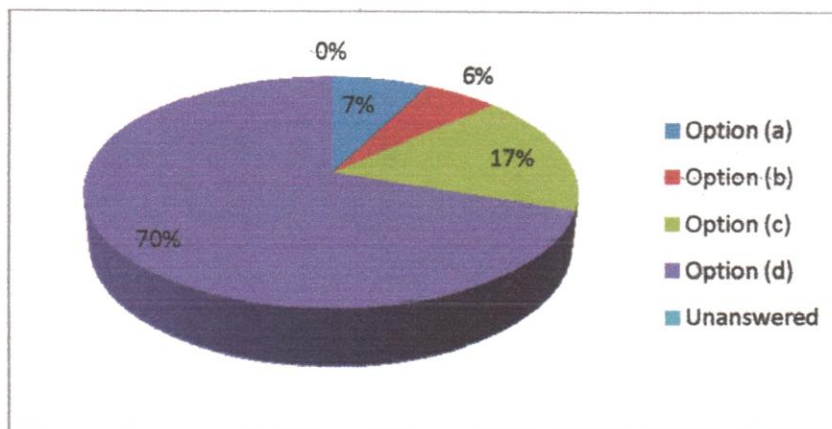
Question 1. Which among the following comes under unisexual organisms?

This question was considered as an easy one because most of the students (79%) gave correct answers i.e., option b, with correct explanation. However some students i.e.: 7(6%), 1(2%) and 3(13%) no. of students chose option a, c and d respectively. On observing the reasons it was seen that some students do understand that 'uni' here refers to 'one' whereas 'sexual' refers to sexual orientation of organism, but they confuse with what is one or uni. Both type of sex organs(male and female) are present in a single body, or one sex organ is present in a single body(either male or female).



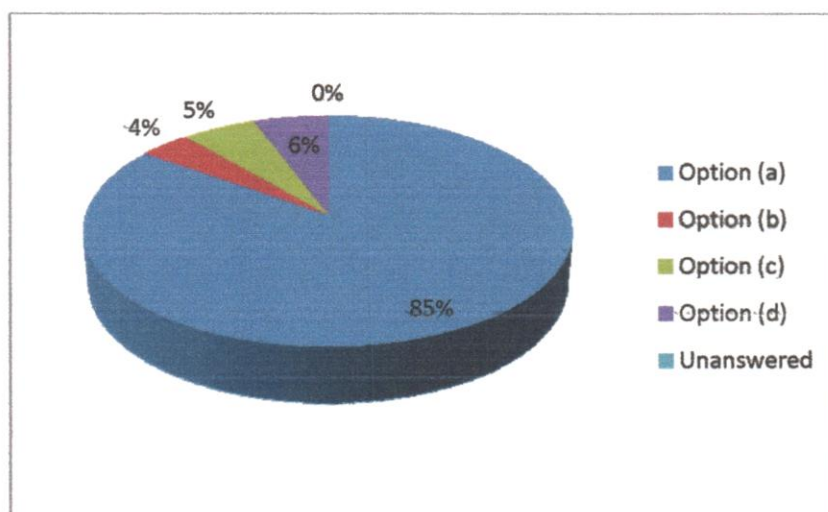
Question 2. Arrange the stages of sexual reproduction in correct order.

Majority of students chose correct answer for this question also providing the correct reason; however some students i.e., 6(6%), 7(7%) and 9(17%) numbers of students chose option 1, 2 and 3 respectively. On observing the reasons given by those particular students, it was seen that they confuse between the general terms of reproduction like fertilization, zygote formation, gametogenesis and embryogenesis.



Question 3. Where is stigma present in a flower?

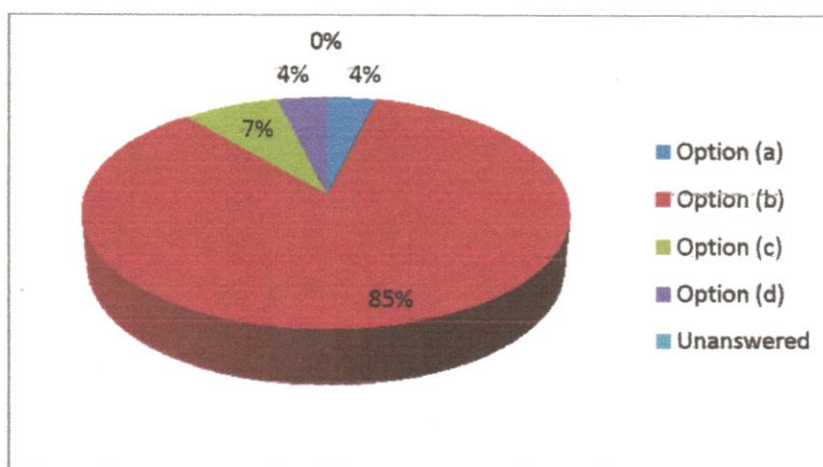
This question is considered to be the easiest question of all the 15 questions. Almost all the students i.e.; 45 students (85%) gave the correct answer providing correct reasons. Very small number of students i.e.; 2, 3 and 3 chose option b, c, and d respectively. No reason was provided by the students choosing the wrong answer, hence making it reasonable to think that the wrong answers chosen may be a lack of content knowledge.



Question 4. Why pollen grains cannot be destroyed so easily in nature?

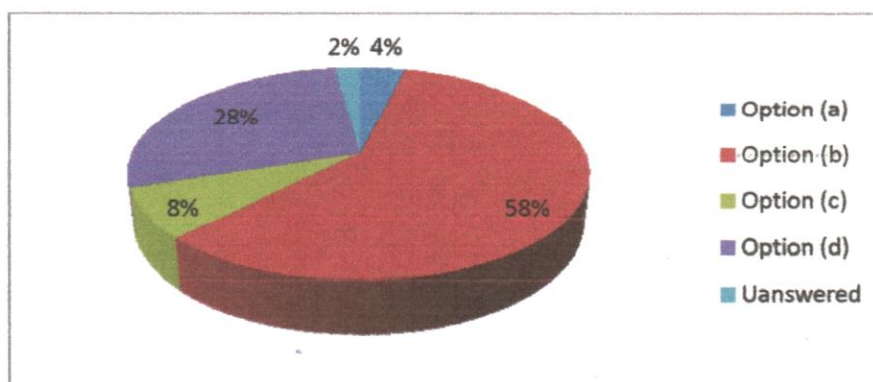
Here too majority of students chose correct answer with correct reasons. Those choosing the wrong answer did not provide adequate reasons or explanations for choosing their options as correct answers according to them, which was again considered

as lack of content knowledge. Also some students believe that while pollination, the pollen grains stick to the skin of the insects and remains preserved, ignoring the fact that pollen grains are very small particles, can be washed off and destroyed easily.



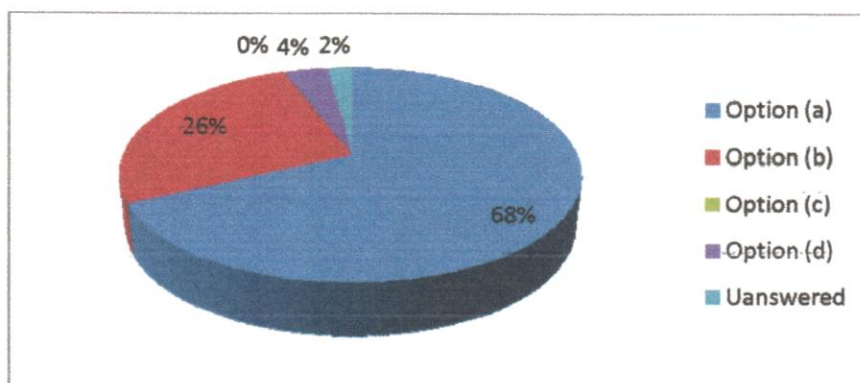
Question 5. A typical mature angiosperm embryo sac is 8-nucleated, 7 celled. Where are those two nucleus present?

Almost all the correct answers chosen were reasoned properly with explanation. Those answers which were not answered correctly, majorly(28%) chose option d, which shows similar terms used in question and the option, made them confused(“...where are the two nucleus present” and “in between the two synergid cells”).



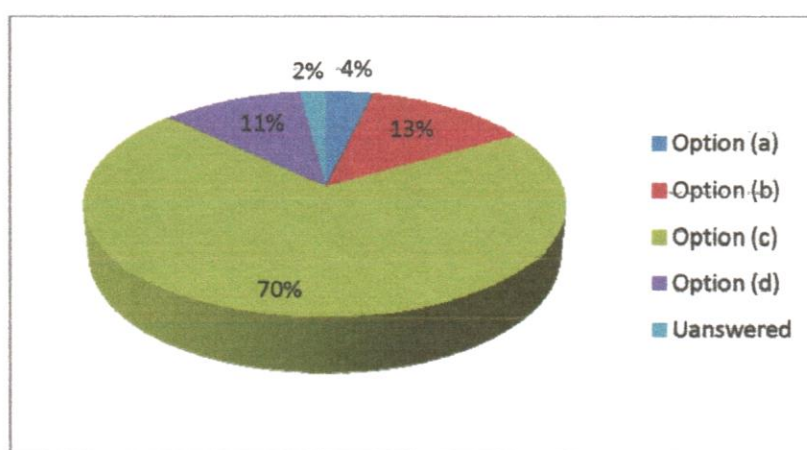
Question 6. What does Double Fertilization mean?

Here most of the students i.e.; 36 students (68%) students answered correctly and explained well. Those choosing wrong answer mostly (26%) chose option b. This shows that students have confusion in terms like 'zygote' and 'egg cell'.



Question 7. Why do you think amniocentesis is banned?

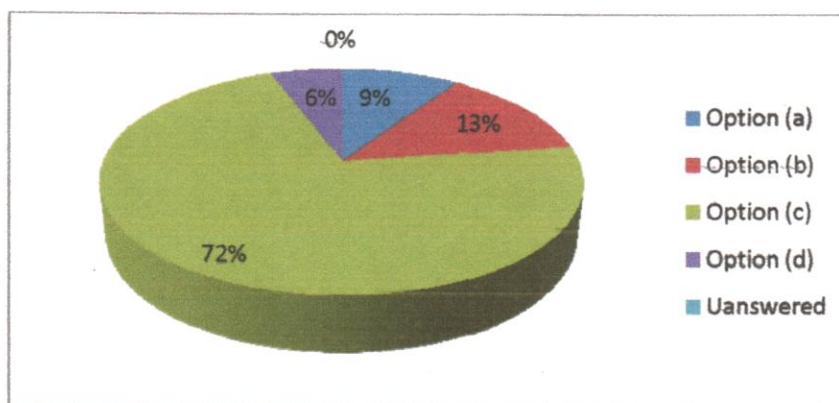
Most students (70%) answered correct answer with correct explanation. Those who did not choose correct answers chose option b (13%) and option d (11%) showing some alternative conceptions is the explanation part. Analysis of reasons show that some students don't know about amniocentesis and those who know, think amniotic fluid extraction from mothers body is unethical, ignoring the fact that it was initiated with a noble cause to diagnose any genetic disease in the foetus.



Question 8. Which among the following is illegal?

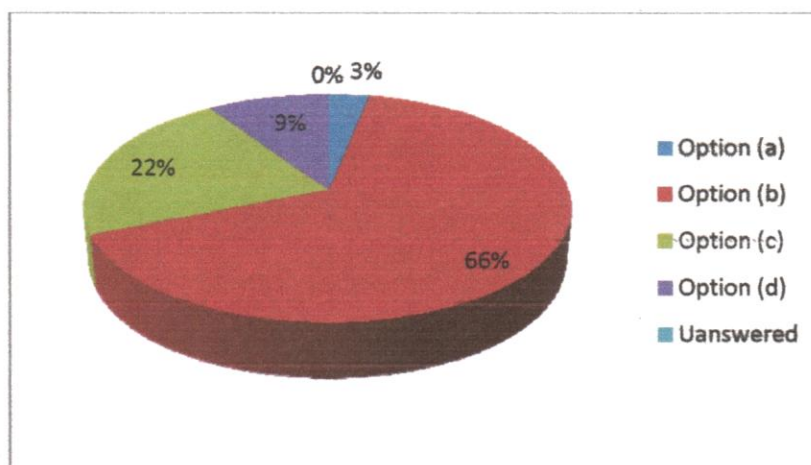
Most students (72%) have chosen correct answer with correct explanation whereas 13% students think medical termination of pregnancy is illegal, even when there

is a genuine cause. 6% students think consuming contraceptive pills is illegal and 9% of them think taking contraceptive methods to avoid pregnancy are illegal.



Question 9. When does the first meiotic division of primary oocyte completes?

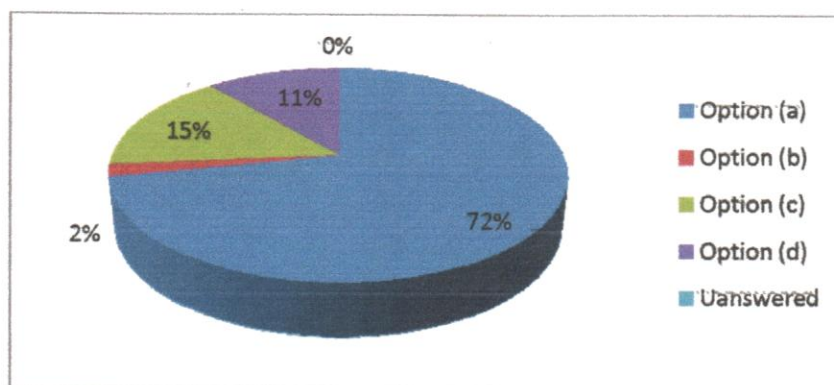
This is the only question where, the wrong answers were more than right answers. Only 22% students chose the correct answer with correct explanation. Most students (68%) think the correct answer is option b. The large number of wrong answers and reasons showed the higher level of alternative conception.



Question 10. When the probability of fertilization of gametes is highest during a menstrual cycle?

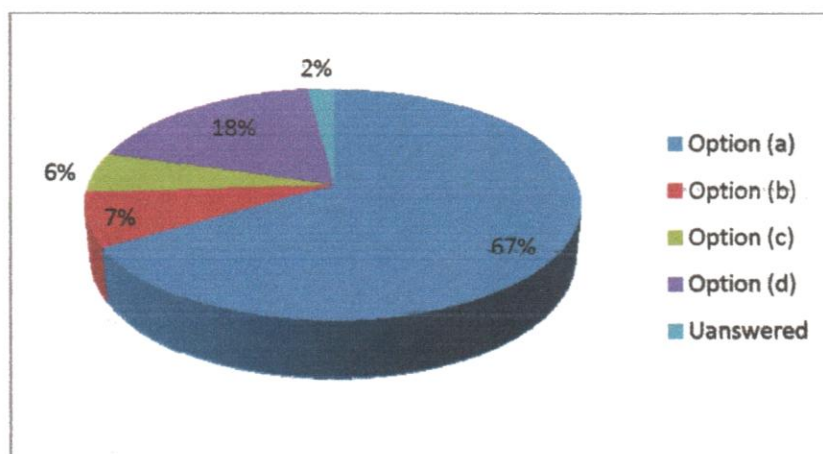
Concept of menstrual cycle is bit confusing as seen through review of related literature. However most students(70%) chose the correct answer i.e.; option a. Some

students chose option c(15%) and option d(16%) but no proper reason was provided by them showing lack of content knowledge in the concept.



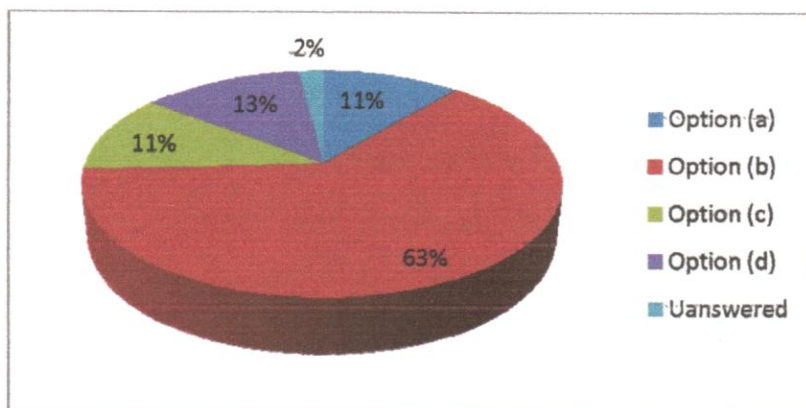
Question 11. What is the role of oxytocin in pregnancy?

Oxytocin is a major hormone during pregnancy but only 67% of students provided correct answer with explanation. 7% students chose option b, which is actually after pregnancy effect, 6% students linked oxytocin with stopping other hormones which is again and wrong explanation whereas 18% of students think oxytocin is linked with providing oxygen to foetus which is again a naive conception.



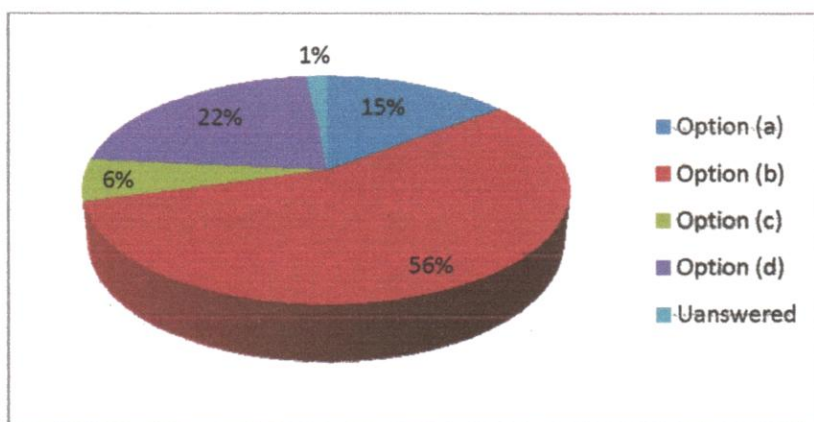
Question 12. Which among the following is haploid?

Here most students (63%) chose the correct answer with correct explanation. However few percent of students i.e.; 11%, 11% and 13% chose the wrong answers without providing adequate explanation or reason considering it a lack of content knowledge.



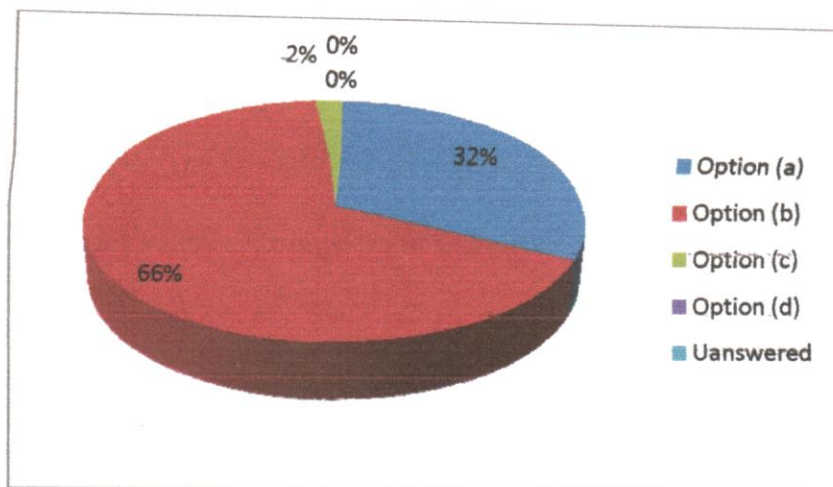
Question 13. Which among the following helps in the transportation of essential substances from placenta to foetus?

Because of the similarity in terms students confused and chose wrong options. It was concluded so because the reasons provided were correct except replacing the particular term with similar ones provided in the options, like placental villi, chorionic villi and placenta.



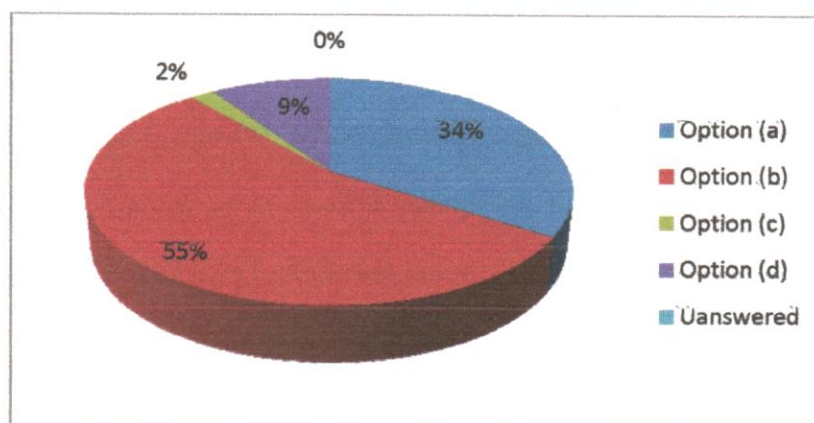
Question 14. What is the part of apple we eat called?

Majority of students chose the correct answer i.e.; thalamus, whereas most students chose option a, i.e.; fruit, because it is the everyday category in which apple is included and biologically it is different.



Question 15. What is the function of cotyledon in seeds?

Here 55% of students thought that function of cotyledon is to provide food during dormancy, ignoring the fact that during dormancy almost all the metabolic function of seed is ceased. Only few students (34%) answered that the correct answer option a, with correct explanation.



4.3. Data analysis of interview schedule

Interviews were scheduled in order to diagnose the source of alternative conception, which is the second objective of the study. It was carried out with students who have given at least 5 to 10 correct answers in the MCQ part of Two Tier Diagnostic Test out of total 15 questions. Following are the concepts included in the study,

alternative conception among them and their probable sources on the basis of interview schedule.

- **Asexual and sexual reproduction in organisms:**

Students mostly are clear about the concept of sexual and asexual reproduction. Somehow few students confuse the term unisexual and bisexual, as the term 'uni' and 'bi' is used to refer body of the organism or its sexual orientation. Also many students are unable to arrange the stages of sexual reproduction in correct order which is one of the basic concepts of the topic. When asked in interview for the same, some students were totally unable to explain the terms, showing lack of content knowledge.

Many students have alternative conception that the sexual reproduction process starts with fertilization. Actually the formation of gametes (gametogenesis) itself is the first step for sexual reproduction, which later fertilize (fertilization of male and female gametes) to give zygote and embryo.

Probable sources of alternative conception found: The cause of alternative conception found is lack of content knowledge for this topic.

- **Sexual reproduction in flowering plants:**

There are least incorrect answers seen in this topic. Most students have correct knowledge of the positioning of reproductive parts in flower, about pollen grains, double fertilization and structure of mature angiosperm embryo. Some students showed up choosing wrong answers, because they confused the two nucleus in question with two synergid cells in the fourth option.

Probable sources of alternative conception found: The source of alternative conception was found to be lack of content knowledge and misreading of terms given in questions.

- **Seed and false fruit:**

Students possess alternative conceptions in this field. many of them think apple is a fruit but biologically it comes under false fruit category, and originally it is thalamus which we eat. Students also think that the cotyledon store food for the period during dormancy, whereas according to predefined theories, during dormancy seeds' metabolism is almost stopped and the cotyledon stores food for the time during germination. This shows students' alternative conception in the concept of dormancy.

Probable sources of alternative conception found: Alternative conception found in fruit are due to daily life experience of calling apple as a fruit. Other alternative conceptions related to seed are due to lack of content knowledge.

- **Sexual reproduction in humans:**

Total four questions were asked on this topic. It was analyzed from the answers given during interview schedule that students have lesser alternative conceptions in male reproductive process than in female. Obviously the reason may be the difference in complexity, as female reproductive system can be considered more complex than that in males. Keeping in mind the female reproductive system, students possess alternative conceptions in the development of primary oocyte in females before birth till puberty and after that. Most students chose the option where, the completion of first meiotic division of primary oocyte takes place in the phase between birth till puberty. However, the concept according to textbook⁵, the primary oocyte is formed before the birth of the female foetus, starts meiosis and gets arrested in prophase-1 stage and stays as it was till puberty, inside primary follicle. The completion of this meiotic division

⁵BIOLOGY TEXTBOOK FOR CLASS XII, NCERT.

of each primary oocyte takes place just before ovulation, each month, resulting in formation of secondary oocyte and ovum later.

Alternative conception on the role of oxytocin was also prominent. Many students chose role of oxytocin as it provides oxygen to foetus, just because of the similarity in the term oxytocin and oxygen. Many chose option which said oxytocin helps inducing mammary gland for lactation after pregnancy, which is true, but the question was asked about the role of oxytocin in pregnancy and not after birth. Few students also chose the option which said that the role of oxytocin is to regulate other hormones during pregnancy, and these answers did not followed with any adequate reasons, hence considering it as lack of content knowledge.

It was seen that students posses confusion in terms like placental villi and chorionic villi, which are same structures at different developmental stage during pregnancy.

Probable sources of alternative conception found: It was found that not all students relate to the development of primary oocyte as given in the textbook. In textbook the concept is given in two different context i.e.; gametogenesis and menstrual cycle. Also the clear description of development of primary oocyte with relation to the development in female body is missing. Other alternative conceptions were either misreading of question(role of oxytocin) or naive conceptions⁶ (just because confusion in terms and less adequate reasons provided).

⁶ Having or showing lack of experience or information.

- **Reproductive health:**

Most students do not know the meaning of amniocentesis hence choosing the wrong answer. On the second question from this concept, many students chose the option of taking contraceptive measures as illegal. Dialogues were as

Researcher: Why do you think taking contraceptive pills are illegal?

Student: Because it is harmful for female body and has many side effects.

Researcher: What is the difference between harmful and illegal?

Student: Harmful is something which is bad for us whereas illegal is something that is prohibited by law to perform.

Researcher: Now again read the options and tell, which among those is illegal.

Student: Aborting female foetus should be illegal.

These dialogues reveal that students sometime have the correct knowledge about content but due to language barrier, they misinterpret the concepts with similar words. Also students are shy to talk about reproductive health in biological terms.

Probable sources of alternative conception found: Language barrier is a source of alternative conception for concepts like reproduction. Also the interaction with teacher and society has a great role in formation of alternative conception, which is the source of alternative conception here.

4.4. Discussion

It was analyzed from Two-Tier Diagnostic Test and interview schedule that, most students possess lack of content knowledge, making it hard to analyze the concepts in their mind. Total types of sources of alternative conceptions diagnosed were naive conceptions, alternative conceptions due to language as barrier, due to teacher interaction and social interaction, daily life experience and alternative conceptions due to textbook.