Literature Study on Concepts of Reproductive System for Undergraduate Students

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Abstract: This study aimed to analyze needed to make a diagnostic test in reproductive system. First step is analysis of the concept. Analysis of the reproductive system concept aimed to find important concepts that must be taught to students at the undergraduate level. Concept selection refers to students' cognitive level. In addition, literature studies are also conducted on three research results that examine students' prior knowledge of the reproductive system. The results of the literature study on the handbook are known to have seven main concepts that are important to teach. Each main concept has sub concepts and supporting sub-concepts. While the results of a literature study from previous research show that the concept of gametogenesis and menstruation is often found to lack of knowledge and even misconceptions. Results of this study can be used to develop diagnostic tests for reproductive system topic to determine students' prior knowledge of undergraduate level.

1 INTRODUCTION

Teaching and Education Faculty students have a great opportunity to be used as agents of renewal which will help develop the next generation, because in essence, students who are prospective teachers will return to society and devote their knowledge to the progress of the nation. Before these prospective teachers use the knowledge they have, it must be ensured that their knowledge and understanding of the concept is correct, so that prospective teachers are expected to distance students from misconceptions that can occur. What can be done to prevent the occurrence of misconceptions before learning begins is to do a diagnostic test.

Various types of tests were developed to evaluate the learning process that has taken place. Even so, the test was also carried out at the beginning of learning known as a diagnostic test. Diagnostic tests aim to determine students' initial understanding before learning is done (Gruel & Eryilmaz, 2015, Cimer, 2014). Diagnostic tests conducted before learning is carried out are also useful to determine the extent of misconceptions that occur in students (Keles & Kefeli 2010; Schaffer, 2013).

The results of this diagnostic test can also help teachers in determining learning strategies and choosing the right learning approach. The ease of transfer of knowledge after a diagnostic test is done can help teachers provide various information about concepts that are difficult for students, determine the initial concepts taught, and develop strategies so that learning objectives can be achieved easily or help teachers create heterogeneous learning groups (Ameyaw, 2016; Hailikari *et al*., 2008; Yaghmour *et. al*., 2016). All the benefits of diagnostic tests not only have an impact on the ease of the learning process that will be carried out but also the learning outcomes of students.

Diagnostic tests have been developed in various forms of tests. One of the diagnostic tests developed was a three-tier test diagnostic test. The three-tier test is a diagnostic test that not only can detect student engagement, but also misconceptions and students who do not understand the concepts of Gruel & Aryilmaz, 2015; Kibulut & Geban, 2014; Schaffer, 2013). Diagnostic tests using the three-tier test form have three levels of questions consisting of student concept knowledge, understanding student concepts, and the level of student confidence in solving the given problem (Kutluay, 2005). Student knowledge is seen from giving questions to test concept knowledge, student understanding seen from student answers in choosing reasons, and student confidence level seen from choice of confidence level. Identifying student understanding will greatly help

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facilitate the learning that will be done if given to difficult materials.

Students have understanding about many concepts in human body (Prokop & Fancovicova, 2006). The results of research conducted by Chaniarosi (2014) show that misconceptions in reproductive system material not only occur in students but also misconceptions in teachers. Chaniarosi explained that misconceptions were identified in almost every sub-concept, but in the sub-concept of menstruation the percentage of misconceptions was greater than other sub-concepts. Pertiwi and Salirawati (2014) explained that the high misconception that occurs in this material is due to the many myths that exist in the community which is one of the factors causing students' misconception. The description of the situation indicates that diagnostic tests on reproductive system material are important to be made to identify understanding of prospective science teacher students.

The development of diagnostic tests conducted aims to produce diagnostic test instruments. The diagnostic tests that have been developed can then be used to simplify the learning activities that will be carried out in determining the learning strategies, approaches, and learning models that will be used for learning for prospective science teacher students.

2 METHODOLOGY

2.1 Research Method

The research carried out is a literature study to obtain an overview of the needs that researchers must have before developing research instruments on three-tier test diagnostic tests. The literature review carried out is part of the Treagust (2006) framework in developing question instruments. This literature study only follows two steps from the three steps proposed by Treagust in developing diagnostic test instruments. The stages of literature review are carried out.

The first stage is to identify the concepts to be taught. Identify important concepts in the material developed based on the Campbell Biology Handbook (Urry, et.al. 2017).

The second stage is to collect data from the literature relating to the concept of related material. The data from the literature are then adjusted to identify important concepts that have been made. The literature that used in this research was three past research conducted by Andrej & Rebeka (2017), Ramadhani (2016), and Chaniarosi (2014).

2.2 Data Analysis

The data obtained from each stage of the study were then analyzed descriptively. The data obtained include:

a. Analysis results of the concept identification of the handbook.

b. The results of the identification analysis of concepts that must be emphasized from the analysis of previous researches.

3 RESULTS

Identify concepts that have been carried out based on the Biology handbook by Urry (2017). The results of the identification of concepts that have been carried out indicate that there are seven main concepts that are important to be understood by students. The concepts are detailed with sub concepts. Sub concepts have several supporting sub concepts to clarify the existing sub concepts. Each concept and number of sub concepts are described in Table 1.

Table 1: Main concepts and number of important sub-concepts in reproductive system material.

No.	Main Concepts	Number of Sub-concepts
1.	Animal reproduction consists of sexual reproduction and asexual reproduction	3
2.	Fertilization is the fusion between sperm and ovum that occurs internally or externally	3
3.	Reproductive organs in men consist of external and internal reproductive organs	3
4.	Reproductive organs in women consist of external and internal reproductive organs	3
5.	Gametogenesis is the process of gamete formation	3
6.	Mammalian reproduction is controlled by hormones produced in the hypothalamus, anterior pituitary, and gonads	3
7.	In placental mammals, the embryo will develop in the mother's uterus	4

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Table 2: Review of research results about the concept of reproductive system material.

No.	Research	N	Concept
1.	Andrej & Rebeka (2017)	310	1 Definition of reproduction 2 Difference between sexual and asexual reproduction 3 Meiotic division in gametogenesis 4 Female reproductive organs 5 Male reproductive organs 6 Fertilization 7 Embryo development in the uterus 8 Sex determination 9 Placenta
2.	Ramadhani, *et al*. (2016)	50	1 Structure and function of the organ of the reproductive system 2 Gametogenesis 3 Menstruation 4 Fertilization, pregnancy and childbirth 5 Contraception
3.	Chaniarosi (2014)	8	1 Ovulation 2 Menstruation

Note: N = Number of sample.

The search for the results of research that has been done about prior knowledge about reproductive system material aims to delve deeper into concepts and sub concepts which are still often misconceptions or concepts that are not understood. This identification is carried out on three research results (Andrej & Rebeka, 2017; Ramadhani et al., 2016; and Chaniarosi, 2014). The results of the identification are presented in Table 2.

4 DISCUSSION

Concept analysis is done to find out what concepts need to be emphasized before the diagnostic test instrument is made. The analysis of this concept is based on the simplest science teacher handbook, the Biology book (Urry, 2017). This book contains all biological concepts considering that science teachers are required to be able to teach the concepts of physics and biology in junior high schools. The analysis of the concepts carried out can then be chosen to be taught to students by considering cognitive abilities at the age level of prospective science teacher students. Lutz & Huitt (2004) explain that cognitive abilities of prospective science teacher students are included in the fourth phase of Piaget's theory. In this fourth phase, it is assumed that all prospective science teacher students have been able to enter formal operations characterized by the ability of students to use logical symbols on abstract concepts. Based on these cognitive abilities, it is determined that there are seven main concepts that are important to be taught to prospective science teacher students.

First, animal reproduction consists of sexual and asexual reproduction. Sub concepts that include sub concepts of the definition of sexual reproduction; asexual reproduction; and the reproductive cycle that is influenced by seasons and hormones. In the sub-concept of the definition of sexual reproduction, including male and female gametes, living things hermaphrodite, and the diversity that results from ongoing sexual reproduction. The concept of asexual reproduction is translated into the concepts of self-division, fragmentation and parthenogenesis. In the sub concepts of factors that affect reproduction include the reproductive cycle, the effect of temperature and climate on reproduction, and ovulation in the middle of the reproductive cycle. The sub concept of the definition of reproduction and differences in sexual and asexual reproduction is one of the sub concepts that need to be studied more deeply on diagnostic tests. The results of a study conducted by Andrej & Rebeka (2017) show that there is still a lack of knowledge of test participants regarding this concept. Andrej & Rebeka revealed that only 13% of the test participants had good conceptual understanding of the questionnaire given to the sample.

Second concept is fertilization. The concept of fertilization is supported by sub concepts of external reproduction, internal reproduction, and sexual reproduction in individuals. Sub supporting concepts for asexual reproduction include the criteria for the occurrence of external fertility that occurs outside the body of the organism and the chemical signals released to carry out external reproduction. The emphasis on understanding the sub-concepts of external reproduction is one of the topics asked in the research conducted by Andrej & Rebeka (2017). The results of this study indicate that 45.5% of the test participants still showed a lack of understanding of the concept. Supporting sub concepts for internal fertilization include adaptations made by organisms to carry out internal fertilization and release of pheromones which affect physiology and behaviour. While the sub concepts of sexual reproduction in individuals include sub concepts supporting cell division in the formation of gametes, reproductive

organs and reproductive glands that make up the reproductive system, modifications to the reproductive system of various types of animal groups.

Third, the male reproductive organs consist of sub concepts of external reproductive organs, internal reproductive organs, and accessory glands. The sub-concepts of the external reproductive organs include the structure of the penile structure, physiological erectile tissue, and factors that affect erectile dysfunction. Sub concepts of male internal organs include gonads as sperm producers, development of testicles, and various kinds of reproductive tracts. Sub concept of accessory gland consists of seminal vesicles, prostate gland, and bulboretra gland. The concept of male reproductive organs is also still found lack of understanding of concepts both from the results of research conducted by Andrej & Rebeka (2017) and Ramadhani (2016). Andrej & Rebeka (2017) describe male reproductive organs that are still difficult to understand including Scrotum, Vas deferens, prostate gland, epididymis, seminal vesicles, urethra, and bulboretra glands. The seminal vesicles, urethra and bulboretra glands are organs that have a very high failure rate of understanding, reaching 97-100%. While the penis and testis are reproductive organs that have a very high level of understanding (± 74%).

Fourth, reproductive organs in women include the sub concepts of external reproductive organs, internal reproductive organs, and mammary glands. The structure of the labia mayora, labia minora and other supporting reproductive organs is included in the study of this sub concept. The sub concepts of internal reproductive organs include the structure of the ovaries, fallopian tubes, uterus, cervix, vagina, and the mechanism of ovulation. The sub concept of the mammary gland is defined as the structure and function of the mammary gland itself. In this concept also still found difficulties in understanding the concept. Andrej & Rebeka (2017) explain the conceptual understanding relating to the ovary, fallopian tube, uterus, labia majora, labia minora, cervix, clitoris and vestibular gland is still very low (51-100%). Ramadhani et al. (2016) suggested that the lack of understanding of concepts related to the structure and function of reproductive organs was due to the high use of intuition to answer the questions given.

Fifth concept is gametogenesis consists of the concepts of mitotic division and meiosis, spermatogenesis and oogenesis. The sub concepts supporting spermatogenesis include the stages of sperm formation as the end result of spermatogenesis, while the supporting sub concepts in oogenesis include the stages of ovum formation, polar bodies, the role of hormones in the development of ovum formation. The concept of gametogenesis is one of the concepts examined more deeply by Andrej & Rebeka (2017), Ramadhani et al. (2016) and Chaniarosi (2014). Andrej & Rebeka (2017) and Ramadhani (2016) agree that this concept is still found to be low in understanding of test participants. However, research conducted by Chaniarosi (2014) illustrates the opposite. Chaniarosi stated that the understanding of the test participants on this concept was very good (82.74%).

Sixth, the hormonal concept that controls all physiological processes that occur in the reproductive system, including the role of the hypothalamus in producing GnRH and the role of FSH and LH in sperm formation, the uterine cycle and the ovarian cycle that are affected by hormones. The role of the hypothalamus in producing GnRH is explained in supporting sub concepts with respect to FSH and LH that stimulate the formation of sex hormones, sex hormones, and the role of sex hormones in women and men. Sub concepts regarding the role of FSH and LH in sperm formation are explained by supporting sub concepts related to the role of sertoli cells and leydig cells in producing other reproductive hormones. While the sub concepts of the uterine cycle and ovarian cycle are described in supporting sub-concepts regarding the stages of the uterine cycle and ovarian cycle, the role of hormones in the uterine and ovarian cycles and the oestrous cycle in the primate. The uterine cycle explains the process of menstruation that is related to the ovarian cycle (Urry *et al*., 2017). The sub-concept of menstruation is one of the known concepts that still show a lack of understanding of the concepts of the test participants (Chaniarosi, 2014, Ramadhani *et al*., 2016). Only 37.5% of the test participants were known to understand the concept well.

Seventh, the final concept of plastered mammals and embryonic development are explained in the sub-concept of fertility, embryo development in the uterus, birth process and contraception. The sub-concepts of fertilization include the development of zygotes and embryos. Students are still identified as having difficulties in understanding the concept of fertilization; this can be seen from the question of sex determinants for babies to be born (57.7%) (Ramadhani *et al*., 2016). The concept of embryo development is explained through supporting sub-concepts regarding the stages of embryonic development that occur in three trimesters, hormonal regulation, and the physiological processes of the

fetus while still in the uterus. The birth process is described in a supporting sub-concept regarding hormonal regulation that stimulates contractions until the baby and placenta are removed. Sub concept of contraception is elaborated in supporting sub-concepts including the objectives, methods and various types of contraceptives that have been developed. The sub-concepts relating to fertilization, pregnancy and childbirth still tend towards a lack of understanding of concepts possessed by test participants (Ramadhani *et al*., 2016). As many as 15.87% of the test participants were identified to understand the concept, while the rest still experienced misconceptions, did not know the concept or just guessed.

5 CONCLUSION

The literature study conducted shows that there are seven important concepts in the material of the human reproductive system. Each of these main concepts is explained in supporting concepts and supporting sub concepts. The lowest understanding of student concepts occurs in the concept of gametogenesis and pregnancy. This shows the importance of diagnostic tests to improve the efficiency of the learning process that takes place.

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