DOI: 10.24952/bioedunis.v3i2.13876

Bioedunis Journal
https://jurnal.uinsyahada.ac.id/index.php/Bioedunisi
Vol. 03 No. 02 Desember 2024
E-ISSN : 2829-7601

Misconceptions Among High School Students Regarding The Biological Concepts of Human Reproduction

Faulina Salsabilla*[1]; Defrian Melta[2]
[1] Biology Department, Mathematic and Natural Science Faculty, Universitas Negeri Padang, Padang, Indonesia
[2] Doctoral Science Education Study Program, Mathematic and Natural Science Faculty Universitas Negeri Padang, Padang, Indonesia
*[1]faulinasalsabilla@gmail.com, [2]defrian92@gmail.com

Abstract

The human reproductive system is one of the concepts in biology that requires a high level of conceptual understanding and is closely related to everyday life. This material has interrelated sub-concepts that allow students to understand it. An initial understanding of the reproductive organs is needed. If students' initial understanding is not strong, then understanding the next sub-concept will be prone to misconceptions.The aim of this study was to identify whether misconceptions exist among students and to determine which sub-concepts in the reproductive system are most affected. This study was conducted with 40 students of 11th-grade students from SMAN 12 Padang. Data were collected using CRI (Certainty of Response Index) is a measure of the level of respondents' confidence/certainty in answering each question given. CRI is usually based on a scale and is given together with each question. The data revealed that students had misconceptions in several sub-concepts. The highest misconception rate was in the sub-concept of menstruation at 35%, while the lowest was in the sub-concept of gamet formation at 20%. These misconceptions likely arise from students forming their own interpretations based on textbooks and teachers' explanations.

Keywords: *human reproduction, misconceptions, ovulation, meiosis, menstrual cycle.*

INTRODUCTION

Conceptual understanding is a person's ability to know or understand, analyze, differentiate, provide examples, apply, rewrite, and conclude a concept that has been previously studied. Conceptual understanding is a person's ability to know or understand, analyze, differentiate, provide examples, apply, rewrite, and conclude a concept that has been previously studied. The explanation of the phenomenon or conception is sometimes not in accordance with the scientific explanation. This can result in errors in understanding the concept or give rise to alternative concepts that if not changed will continue to be integrated into the student's cognitive structure. This can result in misconceptions in students.

DOI: 10.24952/bioedunis.v3i2.13876

Misconception is an understanding of a concept or principle that is inconsistent with the generally accepted interpretation or view of the concept. Conceptions are generally built on common sense or built intuitively in an effort to give meaning to their everyday world of experience and are only pragmatic explanations of the world of reality. Misconceptions can arise from students' daily experiences, which may not align with scientific explanations or principles (Duda *et al*., 2021). This misalignment can lead to the formation of incorrect beliefs that persist even in the face of new information. Furthermore, Prayitno *et al*. (2020) categorize misconceptions into three types: pure misconceptions, false positives, and false negatives, illustrating the complexity of students' understanding and the various ways in which misconceptions can manifest.

Teachers also play a critical role in the propagation of misconceptions. Their own misunderstandings can inadvertently be communicated to students, perpetuating incorrect beliefs. Yates & Marek (2014) emphasize the importance of teachers being aware of the misconceptions that students hold, particularly in subjects like biology, where misconceptions about evolution are prevalent. If teachers are not cognizant of these misconceptions, they may fail to address them effectively, allowing them to persist and hinder students' learning. Moreover, Nelson *et al*. (2017). argue that misconceptions are often reinforced when students are not made aware of their incorrect understandings, suggesting that educators need to actively engage students in discussions about common misconceptions in their fields.

Textbooks and instructional materials are another significant factor contributing to student misconceptions. The way concepts are presented in textbooks can either clarify or confuse students' understanding. Aksoy & Erten (2022) found that misconceptions about global warming often stem from oversimplified or misleading information presented in educational materials. This highlights the need for textbooks to provide accurate and comprehensive explanations of scientific concepts to prevent the formation of misconceptions.

Misconceptions significantly impact student learning outcomes because they can hinder the understanding of biological concepts. Biological concepts serve as the foundational building blocks of scientific literacy, enabling students to articulate and connect various phenomena encountered in daily life. High school students often struggle with cell concepts due to their abstract nature and the complexity of the terminology involved, which can hinder their overall understanding of biology (Luthfyanti, 2024). Lack of prior knowledge can exacerbate difficulties in grasping abstract biological topics, thereby emphasizing the need for effective instructional strategies that cater to students' varying levels of understanding (Soltura, 2021).

DOI: 10.24952/bioedunis.v3i2.13876

Semilarski *et al*. (2019) discuss the development of students' biological conceptual understanding over time, highlighting the need for ongoing assessment to track progress and identify areas for improvement. The integration of conceptual frameworks into biology education can also facilitate a deeper understanding of complex concepts. Wahlberg & Gericke (2018) argue that the contextualization of biological concepts, such as protein synthesis, enhances students' understanding by providing a clear framework for how different processes are interrelated.

The interrelatedness of biological concepts necessitates that prior knowledge serves as a scaffold for new learning. Rowland *et al*. (2019), highlight the varying definitions of interest in biology education, suggesting that a deeper understanding of students' interests can enhance their engagement with complex biological ideas. Hsu *et al*. (2021) further emphasize that understanding is often defined as the ability to articulate concepts in one's own words, a skill that is crucial for students as they progress through their biology education.

Misconceptions in biology, particularly in classification, can lead to significant gaps in understanding. For example, Espinoza (2021) found that students often struggle with the classification of living things, indicating that misconceptions are prevalent and require targeted educational strategies to address them effectively. This is particularly relevant in the context of teaching animal classification, where students may rely on non-taxonomic criteria such as habitat or locomotion rather than scientific classifications.

In this research, the focus is on the topic of the human reproductive system, which is one of the key concepts in biology that requires a high level of conceptual understanding and is closely related to everyday life. This topic has interrelated sub-concepts, making prior understanding critical. If students' initial understanding is weak, they are more likely to experience misconceptions when learning subsequent sub-concepts. Therefore, the aim of this study is to determine whether students hold misconceptions and to identify which sub-concepts in the reproductive system are most frequently misunderstood.

RESEARCH METHODS

Methods

This research is a descriptive study. The population in this study were all students of class XI IPA SMAN 12 Padang. The sampling technique in this study was cluster sampling involving 20 students of class XI IPA 1 and 20 students of class XI IPA 2. The CRI (Certainty of Response Index) test was then administered to the selected students, and their responses were collected for further analysis. The question criteria can be seen in Table 1.

DOI: 10.24952/bioedunis.v3i2.13876

Table 1. CRI question criteria with reproductive system material.

Sub-concepts	Number of questions
Structure and function of human reproductive organs	4
Gamete formation	4
Ovulation	4
Menstruation	4
Fertilization, gestation, labor, and lactation	4
Reproductive organ disorders	4
Total	24

Data Analysis

Students' responses were analyzed to determine whether they Conceptual Understanding (CU), Misconception (M), and Lack of Conceptual Understanding (LCU)**.** The categorization was achieved by evaluating the students' test responses alongside their confidence ratings (CRI scores). Scoring and tabulating the CRI index for each student. Determining students who do not know the concept, misconceptions and know the concept in each sub-concept of the reproductive system tested by referring to the provisions in the following Table 2.

Table 2. Criteria for Conceptual Understanding, Misconception, and Lack of Understanding

Criteria for Responses	Low CRI Score (<2.5)	High CRI Score (>2.5)
Correct	Lack of Conceptual Understanding (Guessing)	Conceptual Understanding
Incorrect	Lack of Conceptual Understanding (Guessing)	Misconception

(Hasan *et al*., 1999)

RESULTS AND DISCUSSION

This study was carried out in July 2024 with 40 students from class XI IPA. The CRI test results revealed that the students exhibited misconceptions in specific sub-concepts, which are outlined in Table 3.

Table 3. The presentation of misconceptions, lack of understanding, and accurate knowledge of high school students regarding the reproductive system material.

Sub-concepts	CU	M	LCU	Total

DOI: 10.24952/bioedunis.v3i2.13876

Structure and function of human reproductive organs	85	0	15	100
Gamete formation	60	20	20	100
Ovulation	50	30	20	100
Menstruation	50	35	15	100
Fertilization, gestation, labor, and lactation	65	25	10	100
Reproductive organ disorders	92,5	0	7,5	100

Conceptual Understanding (CU), Misconception (M), and Lack of Conceptual Understanding (LCU).

According to Table 3, the results show that almost all students exhibited misconceptions across various sub-concepts, except for the sub-concepts of the Structure and Function of the Human Reproductive Organs and Reproductive Organ Disorders, which did not display any misconceptions. Other sub-concepts showed varying degrees of misconceptions among students. The highest rate of misconceptions was found in the sub-concept of Menstruation, with 35%, while the lowest rate occurred in the sub-concept of Gamete Formation, with only 20%. Misconceptions were also observed in the sub-concepts of Fertilization, Gestation, Labor, and Lactation (25%), and Ovulation (30%).

Based on the CRI test, the percentage comparison of misconceptions shown in Figure 1, revealed that two sub-concepts did not exhibit any misconceptions. This is likely because most students had a good understanding of the Structure and Function of the Human Reproductive Organs. However, some students only knew that the female reproductive organ is the vagina and the male reproductive organs are the penis and testes. The data suggests that the incorrect understanding of the reproductive organs was more due to a lack of knowledge rather than a genuine misconception. Similarly, the sub-concept of Reproductive Disorders did not show any misconceptions, as students were generally familiar with reproductive issues, particularly those related to diseases caused by unhealthy or malfunctioning reproductive organs.

DOI: 10.24952/bioedunis.v3i2.13876

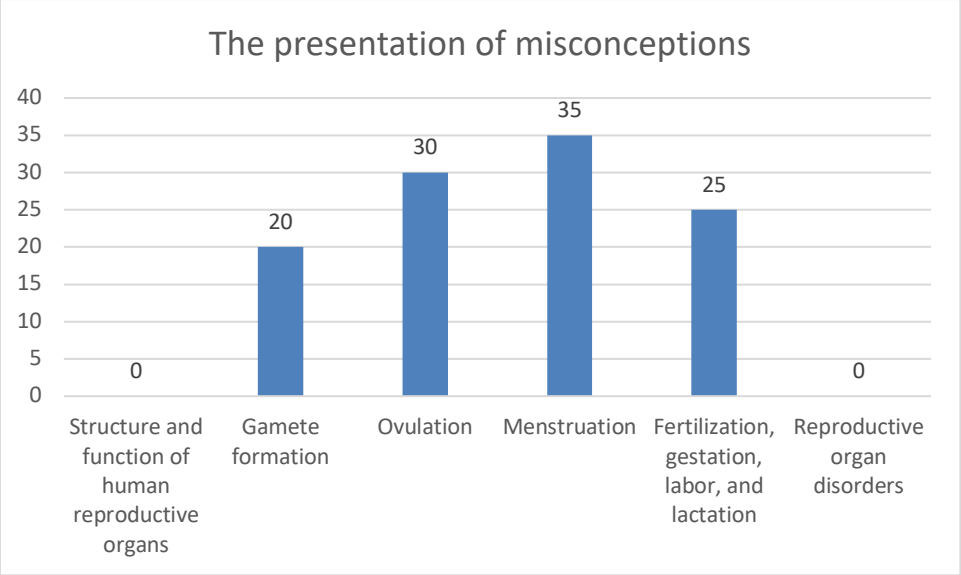

Figure 1. The presentation of misconceptions of high school students regarding the reproductive system material

For example, when asked about disorders or diseases of the reproductive system, such as AIDS, students demonstrated a solid understanding of the disease, including its causes, development, and prevention. Menstruation had the highest misconception rate at 35%. This suggests that many students' understanding is influenced by myths, such as the belief that cold drinks can halt menstruation or that menopause results from depleted ovarian follicles. In reality, menopause occurs when ovarian follicles cease responding to FSH and LH hormones, leading to the cessation of ovulation (Hassan *et al*., 2022; Chothe *et al*., 2014; Ali *et al*., 2020). The perpetuation of these myths is linked to inadequate menstrual health education, which fosters stigma and misinformation (Putriyanti & Ratnawati, 2019; Palupi *et al*., 2020; Maulingin-Gumbaketi *et al*., 2022).

Studies indicate that cultural beliefs and societal taboos contribute to misconceptions about menstruation, affecting adolescents' health and hygiene practices (Bukhari, 2023; Kashyap & Choudhari, 2023). Comprehensive sexual education and open discussions about menstruation can mitigate these myths, enhancing understanding and promoting healthier attitudes towards menstruation (Singh, 2023; Jarrah & Kamel, 2012; Neyazi *et al*., 2021). Addressing these misconceptions is crucial for improving menstrual health outcomes and empowering young women (El-Zeftawy, 2012; Garg & Anand, 2015; Karjee & Biswas, 2023). The misconceptions among students may be due to misinterpretations of the information provided by the teacher, though this cannot be generalized.

The sub-concept with the lowest misconception rate was Gamete Formation (20%). Most students understood the process, although some simply memorized it without fully

DOI: 10.24952/bioedunis.v3i2.13876

grasping the underlying concept. The second-lowest misconception rate was observed in Fertilization, Gestation, Childbirth, and Lactation (25%). One misconception found was regarding contraceptive methods, where students mistakenly believed that the use of an intrauterine device (IUD) leads to permanent infertility, whereas it is actually tubectomy that results in permanent contraception. Tubectomy, which involves cutting and tying the fallopian tubes, is recognized as a permanent method of sterilization, while IUDs are classified as long-term but reversible contraceptive methods (Marsaoly & Djama, 2022; Putri, 2023).

Another example was related to pregnancy tests. Students thought that a urine test could confirm pregnancy because the hormones LH and FSH, which are present during the menstrual cycle, could be detected in urine. However, the correct concept is that pregnancy tests primarily detect human chorionic gonadotropin (hCG) in urine, a hormone produced shortly after implantation of a fertilized egg. Contrary to misconceptions, the hormones luteinizing hormone (LH) and follicle-stimulating hormone (FSH) are not indicative of pregnancy; rather, hCG levels rise significantly post-implantation, typically detectable around 11 days after conception by blood tests and about 12-14 days after conception by urine tests (Lis, 2023; Teixeira *et al*., 2014).

The final sub-concept with misconceptions was Ovulation, with a 30% misconception rate. Most students knew about ovulation and its process, but many only memorized the steps without understanding their significance. A prevalent misconception in reproductive biology is the belief that follicle-stimulating hormone (FSH) is the primary hormone responsible for triggering ovulation. In fact, luteinizing hormone (LH) plays a crucial role in this process. FSH is essential for the development of ovarian follicles, but it is the surge in LH that ultimately induces ovulation, as evidenced by the physiological mechanisms governing the menstrual cycle (Richards & Pangas, 2010).

The interplay between FSH and LH is vital; while FSH promotes follicular growth, the LH surge leads to the release of a mature oocyte from the ovary (Ohta *et al*., 2017). This surge is triggered by elevated estrogen levels produced by the developing follicles, which signal the pituitary gland to release LH (Su *et al*., 2017). Thus, understanding the distinct roles of these hormones clarifies the ovulatory process and dispels the misconception surrounding FSH's role in ovulation (Kandaraki *et al*., 2017).

Based on the data, it appears that students' misconceptions arose from errors in interpreting the material related to the reproductive system as presented by the teacher or in textbooks. Research indicates that textbooks are significant contributors to these misunderstandings, with studies revealing that they rank as a primary source of misconceptions

among students (Roy & Mohapatra, 2022). For instance, students struggle with complex biological processes such as oogenesis and gametogenesis, leading to a conflict between their preconceived notions and scientific concepts (Andariana *et al*., 2020).

Additionally, misconceptions are exacerbated by the way reproductive health topics are presented, often resulting in confusion regarding essential concepts like fertilization and menstruation (Taufiq *et al*., 2017). The prevalence of misconceptions is further supported by findings from Permatadewi *et al*., who note that both students and teachers exhibit misunderstandings related to reproductive health, influenced by societal myths and misinformation (Permatadewi *et al*., 2019). Therefore, addressing these misconceptions requires a critical evaluation of educational resources and teaching methodologies.

Based on these findings, preventive and corrective measures can be suggested. To enhance student learning and address misconceptions effectively, educators should implement several strategic measures. Engaging students with thought-provoking questions at the start of lessons can significantly boost their interest and motivation, fostering a conducive learning environment (Kiros *et al*., 2023). Additionally, administering diagnostic tests at the beginning or end of lessons allows educators to assess students' understanding and identify areas needing clarification (Abeya *et al*., 2021). Regular homework assignments and reviews further reinforce learning and provide opportunities for feedback (Odumu *et al*., 2022). Utilizing diverse contexts to explain concepts can help students relate to the material, thereby enhancing comprehension (Al-Hanawi *et al*., 2020). Lastly, conducting frequent oral tests serves as an effective tool for early detection of misconceptions, allowing for timely intervention (Adhena & Hidru, 2020). Collectively, these strategies not only facilitate the identification of misconceptions but also promote a more engaging and responsive educational experience.

When students do have misconceptions, corrective actions for addressing student misconceptions can effectively employ various pedagogical strategies. Frequent oral questioning serves as a means to engage students and assess their understanding, allowing educators to identify misconceptions early on (Corral & Carpenter, 2023). Summarizing key points at the end of lessons reinforces learning and aids retention, as evidenced by studies showing that summarization enhances comprehension and long-term retention of material (Parong & Mayer, 2018). Furthermore, utilizing multiple contexts to explain concepts can deepen understanding, as it encourages students to apply knowledge in varied situations, thereby solidifying their grasp of the subject matter (Kowalski & Taylor, 2017). Regular practice not only fosters comfort in expressing thoughts but also enables teachers to pinpoint and rectify misconceptions more efficiently (Sibicky *et al*., 2020). Overall, these strategies

contribute to a more robust learning environment where misconceptions are actively addressed and corrected.

CONCLUSION

The study reveals that students often struggle with misconceptions, particularly in topics requiring in-depth comprehension and interconnected ideas. These misconceptions typically arise because students independently interpret and draw conclusions from teacher explanations and textbooks without clarifying their understanding with the teacher. As a result, these misunderstandings may persist over time.

REFERENCES

Abeya, S., Barkesa, S., Sadi, C., Gemeda, D., Muleta, F., Tolera, A., & Tufa, A. (2021). Adherence to covid-19 preventive measures and associated factors in oromia regional state of ethiopia. Plos One, 16(10), e0257373. https://doi.org/10.1371/journal.pone.0257373

Adhena, G. and Hidru, H. (2020). <p>knowledge, attitude, and practice of high-risk age groups to coronavirus disease-19 prevention and control in korem district, tigray, ethiopia: cross-sectional study</p>. Infection and Drug Resistance, Volume 13, 3801-3809. https://doi.org/10.2147/idr.s275168

Aksoy, A. and Erten, S. (2022). A four-tier diagnostic test to determine pre-service science teachers' misconception about global warming. Journal of Baltic Science Education, 21(5), 747-761. https://doi.org/10.33225/jbse/22.21.747

Al-Hanawi, M., Angawi, K., Alshareef, N., Qattan, A., Helmy, H., Abudawood, Y., … & Alsharqi, O. (2020). Knowledge, attitude and practice toward covid-19 among the public in the kingdom of saudi arabia: a cross-sectional study. Frontiers in Public Health, 8. https://doi.org/10.3389/fpubh.2020.00217

Ali, S., Baloch, M., Riaz, L., Iqbal, A., Riaz, R., Perveen, B., & Ali, A. (2020). Perceptions, practices, and challenges regarding menstrual hygiene among women in karachi, pakistan: a comparison between general population and healthcare workers. Cureus. https://doi.org/10.7759/cureus.9894

Andariana, A., Zubaidah, S., Mahanal, S., & Suarsini, E. (2020). Identification of biology students' misconceptions in human anatomy and physiology course through three-tier diagnostic test. Journal for the Education of Gifted Young Scientists, 8(3), 1071-1085. https://doi.org/10.17478/jegys.752438

Bukhari, G. (2023). Myths and challenges regarding menstrual hygiene among adolescent girls of islamabad. Pakistan Journal of Public Health, 13(4), 168-171. https://doi.org/10.32413/pjph.v13i4.1233

Chothe, V., Khubchandani, J., Seabert, D., Asalkar, M., Rakshe, S., Firke, A., … & Simmons, R. (2014). Students' perceptions and doubts about menstruation in developing countries. Health Promotion Practice, 15(3), 319-326. https://doi.org/10.1177/1524839914525175

Corral, D. and Carpenter, S. (2023). Long-term hypercorrection, return errors, and the transfer of learning in the classroom.. Journal of Applied Research in Memory and Cognition, 12(2), 208-229. https://doi.org/10.1037/mac0000048

Duda, H., Wibowo, D., Wahyuni, F., Setyawan, A., & Subekti, M. (2021). Examines the misconceptions of students biology education: health biotechnology. Pedagogika, 142(2), 182-199. https://doi.org/10.15823/p.2021.142.10

El-Zeftawy, A. (2012). The effect of educational intervention on the practice of menstrual hygiene among rural adolescent students in el-mehala el- kobra villages in gharbia governorate. Tanta Scientific Nursing Journal, 2(2), 22-49. https://doi.org/10.21608/tsnj.2012.107804

Espinoza, F. (2021). Does size matter? animal, living and non-living classification, implications for teaching. International Journal of Educational Methodology, 7(3), 465-472. https://doi.org/10.12973/ijem.7.3.465

Garg, S. and Anand, T. (2015). Menstruation related myths in india: strategies for combating it. Journal of Family Medicine and Primary Care, 4(2), 184. https://doi.org/10.4103/22494863.154627

Hassan, M., Doumat, G., Daher, D., Tannir, A., Hassan, B., Chidiac, C., … & Fouad, F. (2022). Menstrual health and period poverty in lebanon during economic crisis: a qualitative analysis of the challenges and recommendations. Frontiers in Reproductive Health, 4. https://doi.org/10.3389/frph.2022.920461

Hsu, J., Lo, S., & Sato, B. (2021). Defining understanding. The American Biology Teacher, 83(6), 372-376. https://doi.org/10.1525/abt.2021.83.6.372

Jarrah, S. and Kamel, A. (2012). Attitudes and practices of school-aged girls towards menstruation. International Journal of Nursing Practice, 18(3), 308-315. https://doi.org/10.1111/j.1440-172x.2012.02032.x

Kandaraki, E., Chatzigeorgiou, A., Papageorgiou, E., Piperi, C., Adamopoulos, C., Papavassiliou, A., … & Diamanti-Kandarakis, E. (2017). Advanced glycation end

products interfere in luteinizing hormone and follicle stimulating hormone signaling in human granulosa kgn cells. Experimental Biology and Medicine, 243(1), 29-33. https://doi.org/10.1177/1535370217731288

Karjee, S. and Biswas, P. (2023). Menstrual hygiene practices and its predictors among young women in india: findings from the national family health survey-5 (2019–2021). Nursing & Midwifery Research Journal, 19(2), 90-104. https://doi.org/10.1177/0974150x231158472

Kashyap, V. and Choudhari, S. (2023). Menstrual hygiene problems and challenges faced by adolescent females in rural areas: a narrative review. Cureus. https://doi.org/10.7759/cureus.40438

Kiros, M., Gebru, S., & Tewelde, B. (2023). Knowledge, attitude, practice and associated factors towards covid-19 and its prevention measures among residents of mekelle city, tigray region, northern ethiopia: a community-based cross sectional study. Journal of Public Health, 32(3), 369-384. https://doi.org/10.1007/s10389-023-01826-3

Kowalski, P. and Taylor, A. (2017). Reducing students' misconceptions with refutational teaching: for long-term retention, comprehension matters.. Scholarship of Teaching and Learning in Psychology, 3(2), 90-100. https://doi.org/10.1037/stl0000082

Lis, K. (2023). From cereal grains to immunochemistry—what role have antibodies played in the history of the home pregnancy test. Antibodies, 12(3), 56. https://doi.org/10.3390/antib12030056

Luthfyanti, J. (2024). High school students' interests, difficulties, and conceptual understanding of cell concepts. Biodidaktika Jurnal Biologi Dan Pembelajarannya, 19(1), 29. https://doi.org/10.30870/biodidaktika.v19i1.24180

Marsaoly, S. and Djama, N. (2022). Exploring factors affecting the mother's knowledge about intrauterine device (iud) in bastiong karance district of ternate city. International Journal of Advanced Health Science and Technology, 2(2), 69-73. https://doi.org/10.35882/ijahst.v2i2.3

Maulingin-Gumbaketi, E., Larkins, S., Whittaker, M., Rembeck, G., Gunnarsson, R., & Redman-MacLaren, M. (2022). Socio-cultural implications for women's menstrual health in the pacific island countries and territories (picts): a scoping review. Reproductive Health, 19(1). https://doi.org/10.1186/s12978-022-01398-7

Nelson, K., McKenna, A., Brem, S., Hilpert, J., Husman, J., & Pettinato, E. (2017). Students' misconceptions about semiconductors and use of knowledge in simulations. Journal of Engineering Education, 106(2), 218-244. https://doi.org/10.1002/jee.20163

Neyazi, A., Faizi, G., Afzali, H., Ahmadi, M., Razaqi, N., Frough, Z., … & Bhattacharya, S. (2021). Assessment of knowledge, attitude and practice about the menstruation among secondary school girls in herat, afghanistan - a cross sectional study.. https://doi.org/10.21203/rs.3.rs-847912/v1

Odumu, P., Akunne, J., Ogeriya, A., Olugbade, O., Idoko, P., Yusuf, M., … & Olasinde, T. (2022). Knowledge and practice of covid-19 preventive measures in an internally displaced persons camp, zonkwa, kaduna state, nigeria - an observational study. Central African Journal of Public Health, 8(1), 13. https://doi.org/10.11648/j.cajph.20220801.13

Ohta, A., Tsunoda, Y., Tamura, Y., Iino, K., Nishimura, N., Nishihara, H., … & Kato, Y. (2017). Construction and expression of vectors encoding biologically active rodent gonadotropins. Journal of Reproduction and Development, 63(6), 605-609. https://doi.org/10.1262/jrd.2017-091

Palupi, T., Pristya, T., & Novirsa, R. (2020). Myths about menstrual personal hygiene among femaleadolescents. Kesmas National Public Health Journal, 15(2). https://doi.org/10.21109/kesmas.v15i2.2719

Parong, J. and Mayer, R. (2018). Learning science in immersive virtual reality.. Journal of Educational Psychology, 110(6), 785-797. https://doi.org/10.1037/edu0000241

Permatadewi, S., Zen, D., & Haryani, M. (2019). Prior knowledge mapping on natural science. Journal of Biology Education, 8(1), 117-125. https://doi.org/10.15294/jbe.v8i1.27304

Prayitno, S., Arjudin, A., & Hapipi, H. (2020). Analyzing geometry misconception of prospective teachers using three-tier diagnostic test.. https://doi.org/10.2991/assehr.k.200827.031

Putri, N. (2023). Faktor-faktor yang berhubungan dengan penggunaan metode kontrasepsi jangka panjang (mkjp) pada wanita usia 15-49 tahun di wilayah pedesaan di indonesia (analisis data sdki 2017). Jurnal Kesehatan Masyarakat (Undip), 11(5). https://doi.org/10.14710/jkm.v11i5.38572

Putriyanti, C. and Ratnawati, E. (2019). Normal puberty knowledge and adolescent menstrual cycles. Jurnal Info Kesehatan, 17(2), 119-133. https://doi.org/10.31965/infokes.vol17.iss2.296

Richards, J. and Pangas, S. (2010). The ovary: basic biology and clinical implications. Journal of Clinical Investigation, 120(4), 963-972. https://doi.org/10.1172/jci41350

Rowland, A., Knekta, E., Eddy, S., & Corwin, L. (2019). Defining and measuring students' interest in biology: an analysis of the biology education literature. Cbe—life Sciences Education, 18(3), ar34. https://doi.org/10.1187/cbe.19-02-0037

Roy, A. and Mohapatra, A. (2022). A gender-based investigation of indian senior secondary students' misconceptions about plant reproduction through concept inventory. Interdisciplinary Journal of Environmental and Science Education, 18(4), e2287. https://doi.org/10.21601/ijese/12089

Semilarski, H., Laius, A., & Rannikmäe, M. (2019). Development of estonian upper secondary school students' biological conceptual understanding and competences. Journal of Baltic Science Education, 18(6), 955-970. https://doi.org/10.33225/jbse/19.18.955

Sibicky, M., Klein, C., & Embrescia, E. (2020). Psychological misconceptions and their relation to students' lay beliefs of mind. Teaching of Psychology, 48(2), 103-109. https://doi.org/10.1177/0098628320959925

Singh, S. (2023). Awareness about menstrual hygiene management among visually impaired adolescent girls. Journal of Ecophysiology and Occupational Health, 211-220. https://doi.org/10.18311/jeoh/2023/34656

Soltura, R. (2021). Designing context-based video instruction in enhancing the conceptual understanding of grade xi students. Indonesian Journal of Educational Research and Review, 4(3), 409. https://doi.org/10.23887/ijerr.v4i3.41635

Su, H., Yi, Y., Wei, T., Chang, T., & Cheng, C. (2017). Detection of ovulation, a review of currently available methods. Bioengineering & Translational Medicine, 2(3), 238-246. https://doi.org/10.1002/btm2.10058

Taufiq, L., Sriyati, S., & Priyandonko, D. (2017). Students' conceptual change on human reproduction concept using scientific approach. International Journal of Science and Applied Science Conference Series, 2(1), 216. https://doi.org/10.20961/ijsascs.v2i1.16714

Teixeira, S., Ferreira, N., Conlan, R., Guy, O., & Sales, M. (2014). Chitosan/aunps modified graphene electrochemical sensor for label-free human chorionic gonadotropin detection. Electroanalysis, 26(12), 2591-2598. https://doi.org/10.1002/elan.201400311

DOI: 10.24952/bioedunis.v3i2.13876

Wahlberg, S. and Gericke, N. (2018). Conceptual demography in upper secondary chemistry and biology textbooks' descriptions of protein synthesis: a matter of context?. Cbe—life Sciences Education, 17(3), ar51. https://doi.org/10.1187/cbe.17-12-0274