Nursing Current: Jurnal Keperawatan

Journal Homepage: https://ojs.uph.edu/index.php/NCJK/

Original Research

Descriptive Cross-Sectional Study on Nursing Students' Understanding of Human Physiology Concepts in Basic Biomedical Science Education

Asih Luklu Susiati[12*], Hardianto[3], Ambo Anto[4], Zainul Muttaqin[5]

1Biomedical Science, Universitas Famika, Indonesia
2Departement of Biology Educational, Graduate School, Universitas Negeri Makassar, Makassar, Indonesia
3Cognifera Education Academy, Indonesia and State University of Malang, Indonesia
4Nursing Science, Universitas Famika, Indonesia
5Hasanuddin University Medical Research Center, Faculty of Medicine, Hasanuddin University, Makassar, Indonesia

ARTICLE INFO

Keywords:

Student understanding

Human physiology

Nursing

Biomedical science

Health education

ABSTRACT

Human physiology is a core subject in nursing education, providing essential knowledge for understanding the human body and applying this knowledge in clinical practice. Despite its importance, many nursing students face difficulties in mastering complex physiological concepts, leading to gaps between theoretical knowledge and practical application. Addressing these challenges is crucial to ensure that future nurses are adequately prepared to deliver safe and effective patient care. This study aimed to evaluate nursing students' understanding of human physiology concepts in basic biomedical science education and to explore differences based on gender and semester level. A descriptive cross-sectional design was conducted with 50 nursing students from the second and fourth semesters at Famika University. Data were collected using a validated 25-item multiple-choice physiology test. Content validity was reviewed by experts, and a pilot test yielded a Cronbach's alpha of 0.82, confirming good reliability. Data were analyzed using SPSS version 26 with descriptive statistics, independent t-tests, and chi-square tests, applying a significance level of $p < 0.05$. The results showed that second-semester students achieved higher comprehension scores (77.75%, Good) than fourth-semester students (68%, Fair). Male students also performed better (81.25%, Good) compared to female students (74.52%, Fair). These findings suggest that variations in students' understanding may be influenced by academic workload, prior learning experiences, and learning motivation. Strengthening physiology education through active learning strategies and better integration of biomedical science content into the nursing curriculum is therefore recommended.

Received 17 May 2025;
Received in revised form 24 July 2025;
Accepted 05 December 2025

https://doi.org/10.19166/nc.v13i2.9828

* Corresponding author.
E-mail addresses: asiluluati@gmail.com

INTRODUCTION

Human physiology is a core component of the nursing curriculum, serving as a foundational discipline that underpins both the theoretical and practical aspects of nursing education (Brown et al., 2017; Wood et al., 2020). It provides essential knowledge for understanding the structure and function of the human body, which is fundamental to clinical reasoning, decision-making, and safe nursing practice. A strong understanding of physiological principles enables nursing students to accurately interpret clinical conditions, apply appropriate interventions, and maintain patient safety throughout their professional careers (Nuuyoma & Fillipus, 2020; Wood et al., 2020). As healthcare systems become increasingly complex, there is a growing need to ensure that physiology learning supports not only theoretical competence but also the application of knowledge in diverse clinical contexts (Astin et al., 2015).

Human physiology plays a pivotal role in nursing education because it provides the essential foundation for understanding the mechanisms of the human body, which in turn informs effective clinical reasoning, patient assessment, and evidence-based decision-making. Mastery of physiological principles is therefore critical to ensuring that nursing graduates are equipped to deliver safe and high-quality care across diverse clinical settings (Ashwathy et al., 2024;Horiuchi-Hirose et al., 2023). Without a solid grounding in physiology, students may struggle to connect basic biomedical concepts with practical nursing interventions, leading to suboptimal clinical performance (Nuuyoma & Fillipus, 2020; Wood et al., 2020). This situation highlights a critical research gap in nursing education, particularly in the Indonesian context, where empirical studies focusing on nursing students' conceptual understanding of physiology remain limited. While international literature has documented challenges and proposed active learning solutions, local evidence is needed to better understand the extent of these difficulties and their implications for curriculum development. Therefore, this study was conducted to analyze the current level of nursing students' understanding of physiology concepts in basic biomedical science education and to provide insights into potential strategies that can bridge the gap between theoretical knowledge and practical application in nursing education (Quiroga & Choate, 2019; Teshome et al., 2021).

To address these learning challenges, educational theories and instructional approaches have increasingly emphasized active and student-centered learning. Constructivist learning theory, for example, encourages students to actively construct knowledge through engagement, reflection, and problem-solving (Ashwathy et al., 2024) . Active learning methodologies, such as problem-based learning (PBL) and inquiry-based learning (IBL), have proven effective in fostering greater student interest and retention of physiological knowledge (Horntvedt et al., 2018; Quiroga & Choate, 2019).

Another critical aspect of comprehending human physiology is the role of Basic Biomedical Sciences, which provides essential foundational knowledge for understanding the complexities of human physiology (Astin et al., 2015; Teshome et al., 2021). A strong grounding in subjects such as biochemistry, anatomy, and genetics enhances students' ability to relate physiological processes to diseases and health conditions, thereby preparing them for practical nursing roles (Brown et al., 2017; Teshome et al., 2021). Furthermore, the inconsistent integration of these sciences into the nursing curriculum can lead to fragmented understanding (Ashwathy et al., 2024; Siddiqui et al., 2022) .

A wealth of studies has highlighted the obstacles that students encounter in mastering physiology. Research across various educational settings illustrates that many students report feelings of inadequacy and confusion regarding physiological concepts, which correlates with their academic performance and confidence in clinical practice (Ashwathy et al., 2024; Wood et al., 2020). For example, some studies have identified low student engagement and limited interest in physiology-related research, often attributed to perceived difficulty and insufficient instructional support (Ashwathy et al., 2024). While international research has explored these challenges and proposed innovative teaching strategies, empirical evidence from Indonesia remains limited (Aboregela et al., 2023; Nuuyoma & Fillipus, 2020). Additionally, further exploration of interdisciplinary approaches and innovative teaching methods is warranted to substantiate the efficacy of modified curricula (Ashwathy et al., 2024; Teshome et al., 2021).

Therefore, this study was conducted to address the existing research gap by analyzing nursing students' understanding of human physiology concepts in basic biomedical science education within the Indonesian context. While previous studies have highlighted the importance of effective teaching methodologies, student engagement, and curriculum design in enhancing physiology learning (Quiroga & Choate, 2019; Teshome et al., 2021), nursing students continue to face significant challenges in linking theoretical physiological concepts with practical application, which may negatively affect academic performance and clinical confidence (Ashwathy et al., 2024; Wood et al., 2020). However, most of these studies have been conducted in Western or other international contexts, while empirical evidence from Indonesia remains scarce. However, most available evidence has been generated in Western or other international settings, and empirical data from Indonesia remain limited.

Accordingly, this study aimed to evaluate the overall level of nursing students' understanding of human physiology and to examine differences based on semester level and gender. By providing locally grounded evidence, this study contributes to the existing body of knowledge and offers practical recommendations for strengthening physiology learning in nursing education through curriculum refinement and the integration of active learning strategies.

METHOD

This study employed a descriptive survey design using a quantitative approach. The study population consisted of undergraduate nursing students enrolled in the Basic Biomedical Science course at Universitas Famika. A total of 85 students were eligible, from which a random sample of 50 participants was selected using simple random sampling to ensure representativeness. The sample size was determined based on feasibility considerations and minimum requirements for quantitative survey research (Creswell, 2012).

The inclusion criteria were nursing students in their second and fourth semesters who had completed coursework in human physiology, were willing to participate voluntarily, and provided written informed consent. Students who were absent during the data collection period or who submitted incomplete responses were excluded from the study.

Data collection was conducted from May 5 to May 7, 2025. A structured questionnaire consisting of 25 multiple-choice items was used to assess students' understanding of human physiology concepts and their application in clinical contexts. The questionnaire was developed based on course learning objectives and prior literature. Content validity was evaluated by three experts in nursing education. A pilot test involving 10 students outside the study sample yielded a Cronbach's alpha of 0.82, indicating good internal consistency.

The questionnaires were administered in a supervised classroom setting, with each student given 30 minutes to complete the test. Participation was voluntary, and written informed consent was obtained prior to data collection. Anonymity and confidentiality were maintained throughout the study.

Data analysis was performed using SPSS version 26. Descriptive statistics, including means, standard deviations, and frequency distributions, were used to summarize students' performance. Independent t-tests were conducted to compare differences between semester levels, while chi-square tests were applied to examine associations between students' understanding and demographic variables. Statistical significance was set at $p < 0.05$.

RESULTS

This study was conducted in May and involved nursing students from the second and fourth semesters, with participants categorized based on gender and academic semester. The demographic characteristics of respondents are presented in Tables 1 and 2.

Table 1. Respondent Characteristics Based on Gender

Gender	Frequency	Presentase
Female	42	84%
Male	8	16%
Total	**50**	**100%**

Table 1 presents the distribution of respondents based on gender. Out of a total of 50 respondents, the majority were female, comprising 42 individuals (84%), while male respondents accounted for only 8 individuals (16%). This significant gender disparity may reflect the actual gender distribution within the academic program under study or a gender-based difference in willingness to participate in academic research.

Table 2. Respondent Characteristics Based on Academic Semester

Semester	Frequency	Presentase
Semester II	30	60%
Semester IV	20	40%
Total	**50**	**100%**

Table 2 shows the distribution of respondents according to academic semester. A total of 30 students (60%) were enrolled in the second semester, while 20 students (40%) were in the fourth semester. This indicates that most participants were in the earlier stage of their academic program.

Table 3. Students' Understanding of Human Physiology Concepts by Gender

Gender	Presentase	Group
Female	74,52 %	Fair
Male	81,25 %	Good

Table 3 illustrates students' understanding of human physiology concepts based on gender. Male students demonstrated a higher mean score (81.25%), classified as "Good", whereas female students achieved a mean score of 74.52%, categorized as "Fair".

The classification of scores was based on established assessment benchmarks frequently applied in educational research, where ≥80% is categorized as Good/High, 70–79% as Fair/Moderate, and <70% as Low/Poor (Arikunto, 2010). These thresholds are consistent with prior studies that employed percentage-based intervals to interpret students' academic performance in health sciences education (Zakar et al., 2024).

Table 4. Students' Understanding of Human Physiology Concepts by Academic Semester

Semester	Presentase	Group
Semester II	77,75%	Good
Semester IV	68%	Fair

Table 4 presents the level of students' understanding of human physiology concepts in relation to their academic semester. Second-semester students attained a comprehension rate of 77.75%, classified as "Good," while fourth-semester students scored lower, at 68%, categorized as "Fair" Interestingly, this finding reveals that students in earlier semesters exhibited a higher level of conceptual understanding than those in more advanced semesters. Possible contributing factors may include academic fatigue, increased workload in higher semesters, or insufficient reinforcement of foundational concepts.

DISCUSSION

Characteristics of Respondents by Gender

The findings of this study revealed that the majority of respondents were female (84%), with only 16% male participation. This gender imbalance is consistent with the general demographic trend in nursing education, where female students typically dominate enrollment (Voyer & Voyer, 2014). Similar results were also reported by Nuuyoma & Fillipus (2020), who found that women constituted the majority of participants in physiology-related studies, reflecting the broader feminization of the nursing profession.

Although the dominance of female respondents may limit the statistical balance between genders, the higher average score obtained by male students (81.25%, categorized as Good) compared to female students (74.52%, categorized as Fair) warrants further consideration. This outcome contrasts with previous meta-analyses which showed that female students often outperform males in academic achievement across disciplines, including health sciences (Voyer & Voyer, 2014). One possible explanation is that differences in learning strategies, motivation, self-efficacy, or prior exposure to science-related subjects may influence conceptual understanding in physiology (Kim, 2024).

From a practical perspective, these results highlight the importance of implementing learning strategies that accommodate diverse learning needs across genders. Active learning methods, such as problem-based learning (PBL) and collaborative group work, have been shown to reduce performance gaps and promote more equitable learning outcomes (Horntvedt et al., 2018; Iqbal et al., 2019). In the Indonesian nursing education context, gender-responsive and inclusive pedagogy may enhance student engagement and comprehension regardless of gender differences.

Characteristics of Respondents by Semester Level

The distribution of respondents based on semester level shows that the majority came from semester II (60%), while the remaining 40% were in semester IV. This finding is important to analyze because the semester level is closely related to cognitive level, academic experience, and exposure to more complex learning content.

According to the theory of cognitive development (Dale, 1946)Students who are in the early stages (semester II) tend to still be in the process of transitioning from concrete thinking to formal operational thinking, while advanced students (semester IV) have more developed abstract and reflective thinking abilities. This has an impact on the way they understand the material, including conceptual topics such as human physiology. Thus, the involvement of undergraduates in this study needs to be analyzed more carefully due to limited understanding due to immature learning experiences.

Similar studies by Vygotsky (1978) and adapted by Kuklinski & Weinstein (2001) emphasize the importance of the Zone of Proximal Development (ZPD) in higher education, where entry-level students need more scaffolding or instructional support in understanding complex material. In this context, second-semester students may not have had adequate exposure to physiology material, in contrast to fourth-semester students who have undergone more learning and practical experiences.

Research by Albloushi et al. (2023) in the context of nursing students also found that the semester level had an effect on the level of understanding and clinical skills, where early students tended to show lower conceptual understanding than advanced students.

Students' Level of Understanding of the Concept of Human Physiology by Gender

The results indicate that male students demonstrated a higher level of understanding of human physiology concepts (81.25%, Good) compared to female students (74.52%, Fair). According to social learning theory (Kim, 2024), this disparity may result from differences in learning experiences, social reinforcement, and self-efficacy, with males exhibiting greater confidence in science subjects, promoting deeper engagement with complex concepts.

However, this finding contradicts a substantial body of literature suggesting that female students often show stronger academic persistence and consistent performance in health education programs (Voyer & Voyer, 2014). Therefore, the observed difference in scores may also be influenced by contextual factors, such as teaching methods, assessment formats, or the unequal gender distribution within the sample, which may introduce statistical bias.

Supporting this interpretation, Iqbal et al. (2019) reported no significant gender differences in physiology comprehension when problem-based learning (PBL) was applied consistently. The study emphasized that teaching effectiveness depends more on pedagogical approaches than gender differences. In contrast, research in the Southeast Asian context by (Voyer & Voyer, 2014) showed that male students tend to excel in logical reasoning-based tests, including in anatomy and physiology courses.

Second, learning evaluation should be adjusted to not only rely on written tests or conceptual memorization, but also accommodate a more contextual and reflective learning approach, where women tend to show excellence. Third, supporting strategies such as academic mentoring programs or self-study training are needed, especially for groups with lower levels of understanding, so that the gap does not widen and the learning process remains inclusive.

Students' Understanding of Human Physiology Concepts by Academic Semester

The findings reveal that second-semester students achieved higher understanding scores (77.75%, Good) compared to fourth-semester students (68%, Fair). This result may appear counterintuitive, but it can be explained by differences in curriculum focus and academic demands across semesters.

Second-semester students primarily engage with foundational

biomedical concepts, allowing them to concentrate more intensively on basic physiology. In contrast, fourth-semester students face increased academic workload, clinical integration, and content complexity, which may reduce their retention and reinforcement of fundamental physiological principles (Astin et al., 2015; Wood et al., 2020). Academic fatigue and shifting learning priorities may further contribute to this pattern.

These findings suggest the importance of vertical curriculum integration, where foundational physiology concepts are continuously reinforced in higher semesters through applied and clinical contexts. Active learning strategies, including Problem-Based Learning (PBL) and case-based discussions, may help bridge the gap between basic biomedical knowledge and clinical application, thereby enhancing long-term comprehension (Horntvedt et al., 2018; Quiroga & Choate, 2019).

CONCLUSION

This study revealed variations in nursing students' understanding of human physiology concepts, with male and second-semester students demonstrating higher scores compared to female and fourth-semester students. These findings highlight the influence of academic workload, prior learning experiences, and motivational factors on students' conceptual comprehension. While the study contributes locally relevant evidence supported by a validated instrument, limitations such as the small sample size, single-site design, and restricted demographic variables indicate that the findings should be interpreted with caution. Future studies involving larger and more diverse institutional settings are recommended to enhance the generalizability of the results and to inform the development of more effective and inclusive teaching strategies in nursing education.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the support of Universitas Famika and the participation of the nursing students who facilitated this research.

REFERENCES

Aboregela, A. M., Sonpol, H. M. A., Metwally, A. S., El-Ashkar, A. M., Hashish, A. A., Mohammed, O. A., Elnahriry, T. A., Senbel, A., & Alghamdi, M. (2023). Medical students' perception and academic performance after team-based and seminar-based learning in human anatomy. Journal of Taibah University Medical Sciences, 18(1), 65–73. https://doi.org/10.1016/j.jtumed.2022.08.005

Albloushi, M., Innab, A., Mofdy Almarwani, A., Alqahtani, N., Anazi, M., Roco, I., & Alzahrani, N. S. (2023). The Influence of Internship Year on Nursing Students' Perceived Clinical Competence: A Multi-Site Study. Sage Open, 13(3). https://doi.org/10.1177/21582440231193198

Ashwathy, V., Avanthi, E., Narayanam, H., & Lokesh, B. (2024). Perception of undergraduate medical students on learning physiology: A descriptive cross-sectional study in a medical school of South India. Journal of Education and Health Promotion, 13(1). https://doi.org/10.4103/jehp.jehp_1077_23

Astin, F., Carroll, D. L., Ruppar, T., Uchmanowicz, I., Hinterbuchner, L., Kletsiou, E., Serafin, A., & Ketchell, A. (2015). A core curriculum for the continuing professional development of nurses: Developed by the Education Committee on behalf of the Council on Cardiovascular Nursing and Allied Professions of the ESC. European Journal of Cardiovascular Nursing, 14(3), 190–197. https://doi.org/10.1177/1474515115572048

Bandura, A. (1986). Social Foundations of Thought and Action: A social cognitive theory (Vol. 1986). Upper Saddle River, NJ: Prentice Hall.

Brown, S. J., White, S., & Power, N. (2017). Introductory anatomy and physiology in an undergraduate nursing curriculum. Advances in Physiology Education, 41(1), 56–61. https://doi.org/10.1152/advan.00112.2016

Dale, E. (1946). Audio-Visual Methods in Teaching. Dryden Press.

Horiuchi-Hirose, M., Fukuoka, T., & Saeki, Y. (2023). Integration of anatomy and physiology into nursing practice as perceived by undergraduate students and registered nurses: a scoping review. BMC Nursing, 22(1), 270. https://doi.org/10.1186/s12912-023-01436-0

Horntvedt, M.-E. T., Nordsteien, A., Fermann, T., & Severinsson, E. (2018). Strategies for teaching evidence-based practice in nursing education: a thematic literature review. BMC Medical Education, 18(1), 172. https://doi.org/10.1186/s12909-018-1278-z

Iqbal, S., Akram, R., Gohar, B., Mahmood, A., Naz, N., & Mudasar, S. (2019). Metacognitive Awareness and Academic Achievement of Medical Students in Different Medical Colleges of Lahore, Pakistan. International Journal of Contemporary Medical Research [IJCMR], 6(9). https://doi.org/10.21276/ijcmr.2019.6.9.32

Kaur, H., & Chadda, I. (2022). Online Education during COVID-19 in Punjab: A Study on Perception of Teachers. Indian Journal of Educational Technology, 4(2), 29–39.

Kuklinski, M. R., & Weinstein, R. S. (2001). Classroom and Developmental Differences in a Path Model of Teacher Expectancy Effects. Child Development, 72(5), 1554–1578. https://doi.org/10.1111/1467-8624.00365

Lazaridou, A. (2024). Gender Differences in Educational Leadership and Values: Adding Insights from a Neuro-Social Perspective. European Journal of Education and Pedagogy, 5(5), 54–61. https://doi.org/10.24018/ejedu.2024.5.5.837

Nuuyoma, V., & Fillipus, S. K. (2020). Nursing students' perceptions and experiences of concept mapping as a

learning tool in a human physiology course. African Journal of Health Professions Education, 12(3), 98. https://doi.org/10.7196/AJHPE.2020.v12i3.1330

Quiroga, M. del M., & Choate, J. K. (2019). A virtual experiment improved students' understanding of physiological experimental processes ahead of a live inquiry-based practical class. Advances in Physiology Education, 43(4), 495–503. https://doi.org/10.1152/advan.00050.2019

Rabia Siddiqui, Saif Ullah Shaikh, Lalarukh Munawar, Iram Saddiqa, & Muhammad Faisal Fahim. (2022). Survey of assessment of teaching learning methods for physiology among undergraduate medical students at a university. The Professional Medical Journal, 29(09), 1420–1425. https://doi.org/10.29309/TPMJ/2022.29.09.7013

Teshome, D., Tiruneh, C., Berhanu, L., & Berihun, G. (2021). Medical Students' Attitude and Perception Towards Basic Medical Science Subjects at Wollo University, Northeast Ethiopia. Advances in Medical Education and Practice, Volume 12, 431–438. https://doi.org/10.2147/AMEP.S309440

Voyer, D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta-analysis. Psychological Bulletin, 140(4), 1174–1204. https://doi.org/10.1037/a0036620

Wood, A. F., Chandler, C., Connolly, S., Finn, G., Redmond, C., Jolly, J., Powell, A. D., Davies, C., & Grant, A. (2020). Designing and developing core physiology learning outcomes for pre-registration nursing education curriculum. Advances in Physiology Education, 44(3), 464–474. https://doi.org/10.1152/advan.00139.2019

Zeyer, A. (2018). Gender, complexity, and science for all: Systemizing and its impact on motivation to learn science for different science subjects. Journal of Research in Science Teaching, 55(2), 147–171. https://doi.org/10.1002/tea.21413