PHYSIOLOGY EDUCATION IN THE INDONESIAN MEDICAL CURRICULUM: CURRENT PROGRESS AND FUTURE PERSPECTIVE

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Abstract

The understanding of physiological science concepts by medical students has substantial relevance as it plays a crucial role as the basic science of medicine. Teaching basic medical science faces a number of challenges that need to be resolved, especially considering the interest of students who tend to be more interested in clinical courses that are considered more directly related to medical practice in the field. As the physiology curriculum evolves, curriculum changes that lead to the implementation of Problem Based Learning (PBL) and curriculum integration have affected the time management for physiology courses for medical students. This will make it a challenge for medical students to face the challenges of the development of the physiology curriculum in the future. Web-based literature search was carried out using several keywords. This article review aims to collect data and articles to explore the existing physiology curriculum in Indonesian medical schools and propose innovative approaches to enhance student participation in physiology education.

Keywords: Medical Curriculum, Medical Education, Physiology, Problem Based Learning (PBL)

1. Introduction

Physiology is one of the subjects included in the scope of basic medical science and has an essential role in the curriculum of medical education curriculum (Yatish *et al.*, 2020). Understanding the concept of physiology for medical students is very important as a basis for knowledge of the work processes in the human body (Balapala, 2015). This is because a good understanding of how normal organs and organ systems work in the human body is the main provision in understanding the pathophysiology and course of a disease (Zante *et al.*, 2020). Therefore, a good understanding of physiology is needed to support students in the clinical phase (Adi and Alturkmani, 2013). In addition, basic medical science is also a foundation in medical education and has a role in improving thinking skills, logical reasoning, critical judgment, problem solving, decision making, and creativity for clinicians and academics so that students have better clinical understanding (Norris *et al.*, 2020).

The retention ability of students who relearn basic medical science and relate it to clinical patient information has a better value when compared to students who only focus on the clinical correlation of the patient's condition (Woods *et al.*, 2006). Chawla *et al.*, (2012) revealed that students were more interested in studying clinical courses than basic medical sciences because they considered that the basic sciences were not relevant to their profession in the clinic. In addition, the integrated curriculum based on Problem Based

Learning that is currently implemented by most Faculties of Medicine in Indonesia cuts the conventional learning time of physiology including practicum, and combines it into an integrated module with the hope that students can learn medical science more comprehensively. This review aims to discuss the current physiology curriculum in medical schools in Indonesia and new strategies to increase student engagement in learning physiology.

Competitions for medical students are an innovative way to promote and stimulate students' active participation in a particular field. For example, in a study of medical students' participation in a "public speaking" competition in the field of psychiatry, the competition has changed students' perspectives on psychiatry to be more positive. In addition, student participation also increases student interest in the field (Agyapong, 2019). In physiology, student participation in competitions also provides more opportunities to apply physiological concepts (Balapala, 2015). The role of lecturers in student competition participation substantively plays a role not only in teaching or transferring knowledge (cognitive), but also required to be able to provide good guidance and training to support the achievements of their students (Tjakradidjaja et al., 2016). Indonesian Medical Physiology Olympiad (IMPhO) is a national competition in the field of medical physiology initiated by the Department of Physiology, Faculty of Medicine, Universitas Airlangga together with the initiator of the same quiz at the international level, Intermedical School Physiology Quiz. similar to its international counterpart, IMPhO attracts a large number of medical students to participate, with more than 60 teams of students competing each year. In its implementation, the competition is divided into several stages, namely a written test and an oral test. In the written test, questions about physiology covering all organ systems are given and aim to test understanding of the basic concepts of physiology and are not memorised questions (Istighfaricha, 2017).

Through observations during the physiology competition, Cheng (2010) gained insight into students' understanding of the concept of physiology and how physiology is taught in each participant's medical education institution. Based on Cheng's research, it can be seen that using a learning method in the form of Intermedical School Physiology Quiz (IMSPQ) to students can provide unique insights into a common area where most medical students globally misunderstand the basic concepts of physiological mechanisms. In addition to being an annual platform for networking amongst future medical professionals, the IMSPQ provides an invaluable setting to highlight common areas where an understanding of physiological processes may need more attention and focus.

2. Physiology for Medical Student

Physiology is a branch of biology that explains the mechanisms of a living organism. The scope of physiology itself is very broad, some of which are viral physiology, bacterial physiology, cell physiology, plant physiology, and human physiology (Hall *et al.,* 2021). Physiology describes the role of very simple molecules to the collaborative function of each organ to support the life of an organism (Widmaier *et al.*, 2019). The complexity of organ systems in humans means that there are still interactions between systems that have not been well explained in physiology to date (Joyner, 2011)

In recent years, there have been many new developments and findings in the field of human physiology, such as the discovery of temperature-sensitive TRP channels by David Julius and Ardem Patapoutian. Their findings could lead to new ways to treat the burning pain felt when eating hot chillies (Bautista, 2015). These conditions allow physiology to further develop in the future along with the development of technology that supports research. With new findings related to physiology, clinicians are expected to learn the most up-to-date methods and techniques as an adaptation to these new findings (Adi and Alturkmani, 2013). This adaptive response is absolutely necessary with the aim of improving the quality of health services. In the medical education curriculum, physiology is one of the subjects included in the scope of basic medical science and has an essential role (Yatish *et al.,* 2020). This is because a good understanding of how normal

organs and organ systems work in the human body is the main provision in understanding the pathophysiology and course of a disease (Zante *et al.*, 2020). Therefore, a good understanding of physiology is needed to support students in the clinical phase (Adi and Alturkmani, 2013). In addition, basic medical science is also a foundation in medical education and has a role in improving thinking skills, logical reasoning, critical judgement, problem solving, decision making, and creativity for clinicians and academics so that students have better clinical understanding (Norris *et al.*, 2020). A very high retention rate for physiology subjects is considered very beneficial by clinical phase students because physiology subjects themselves are very important and relevant in the learning process at the clinical clerkship stage (Adi and Alturkmani, 2013). The retention ability of students who relearn basic medical science and relate it to clinical patient information has a better value when compared to students who only focus on the clinical correlation of the patient's condition (Dixon-Woods *et al.*, 2006).

3. Learning Physiology in The Medical Curriculum

Learning physiology and other basic medical sciences generally takes place in the first to second year of the academic calendar (Crawford, 2021). The physiology learning process can be carried out with a variety of methods. Classical lecture methods, Wet or Dry Laboratory Practicum, Problem Based Learning, and Case Based Learning are some examples of the most common learning methods.

Classical lecture is the most commonly used method in the learning process of physiology. This method is the first choice because it is relatively more economical and practical when the number of students participating in learning is very large and there are limited teaching lecturers available (Alaagib *et al.*, 2019). Balliu (2017) explains that this approach establishes the lecturer as the centre of teaching during class and focuses on the lecturer-led teaching process. The classical lecture method is very effective for conveying a certain concept or knowledge. Classical lectures also play a role in increasing interest and encouraging students to learn independently (Alaagib *et al.*, 2019). This classical teaching method can achieve a higher level of effectiveness if the lecturer delivers the material in a more interactive manner. Lecturers need to actively engage with students by asking questions to students and emphasising the importance of preparedness and checking previous material as part of the learning process (Balliu, 2017).

There are other innovations in the method of learning physiology through classical lectures. According to Phillips and Wiesbauer (2022) the flipped classroom method is a learning approach that requires learners to change their learning activity patterns, both in the classroom and at home. Learners are given pre-class tasks, such as watching short videos, listening to lectures or podcasts, or reading journal articles related to the lecture material or theory to be learnt (self-study). Next, in-class time is directed towards reinforcing and building connections with the knowledge learnt through activities such as discussions, interactive exercises, group learning, and case studies. This approach aims to utilise class time more efficiently and focuses on strengthening understanding as well as application of concepts through activities that require active interaction between learners and the subject matter (Hew and Lo, 2018).

Practical learning methods play an important role in the learning process of physiology (Dohn *et al.*, 2016). Through practicum, students can develop literacy and competence related to basic medical science, especially physiology (Schuijers *et al.*, 2013). Practicum has a role in assisting the learning process, especially to understand complex physiological concepts such as action potentials and cardiac physiology. In addition, there is a positive correlation between the independent practicum process and academic performance as assessed by students' final exams (Dohn *et al.*, 2016). However, students complain about the time-consuming lab learning process, repetitive workflow, and imprecise experimental data. There is a new innovation to modern physiology practicum, namely PhysioEx. PhysioEx is an easy-to-use laboratory simulation software consisting of 12 exercises containing 63 physiology lab activities. This device can be used as a supplement or replacement for wet labs. PhysioEx allows students to repeat labs as often as they

like, perform experiments without endangering live animals, and perform experiments that are difficult to do in a wet lab environment due to time, cost, or safety concerns (Zao, 2014).

Problem Based Learning (PBL) is a holistic approach that encourages students to play an active role in the learning process (Ghani *et al.*, 2021). This learning method is carried out in a small group that emphasises collaboration between students to solve a problem. Students will be actively involved in group discussions and work together in answering a problem. This method makes it easier for students to develop systematic thinking skills that will be useful for understanding how the human body works which is very complex in learning physiology (Vita *et al.*, 2021).

PBL learning has 3 main elements in its implementation, namely individual development, training care between students, and improving functional skills (soft skills). Students are required to be proactive in analysing problems and connecting one knowledge with another. The ability of students in the division of roles and tasks is also tested in the implementation of PBL. In addition, the level of discipline and consistency of students is expected to increase through the implementation of the PBL method. The ability to solve problems through literature review is also an important point in the implementation of PBL. Proactive attitude, ability to divide tasks fairly, consistency, and problem solving skills are points included in the individual development element. (Ghani *et al.*, 2021).

Care between students will be trained through the PBL method, because in its implementation students will provide corrections, evaluations, and feedback to each other's opinions. (feedback) on the opinions conveyed by each student in the discussion. Finally, students' functional skills (soft skills) in the form of time management, information management, and skills for collaboration will increase significantly if the physiology learning process is carried out using the PBL method (Ghani *et al.*, 2021). Problem Based Learning (PBL) as an innovative learning method has some drawbacks that need to be considered to understand its impact on the educational context and its implementation. PBL implementation can have significant cost implications. PBL requires additional resources such as relevant teaching materials, supporting technology, and specialised training for teaching staff. In addition, consistency in the implementation of PBL can be a challenge. Varying interpretations of instructions and lack of consistency between teaching groups can result in a non-uniform learning experience (Abdelkarim *et al.*, 2018).

4. Development of Physiological Science Teaching in Indonesia

The medical education curriculum underwent changes starting from the Indonesian Medical Education Core Curriculum (KIPDI) I, KIPDI II and ending with KIPDI III or Competency-Based Curriculum (KBK). KBK is the latest curriculum introduced by the government in 2001. This KBK is also known as the 2004 Curriculum. This curriculum is still relatively new. Implementation of this curriculum began in 2006. The implementation of this KBK has supporting learning methods. One of them is Problem Based Learning (PBL). PBL was originally implemented by McMaster University in Canada in 1969 (Virk *et al.*, 2022).

The competency-based curriculum (KBK) is implemented using the SPICES method, namely Student Centre, Problem Based Learning, Integrated, Community Based, Early Clinical Exposure, and Structured. The existence of this curriculum, students are required to be more active learners, learn medical science based on existing health problems, and integrated methods between one course and another. Students are also prioritized to learn more about diseases in the community and are early introduced to the clinical atmosphere. Future professional doctors are expected to have good communication with patients and develop empathy (Yusoff, 2019).

The development of physiology learning has made several universities in Indonesia transform their learning curriculum. Most of Indonesia's medical curriculum is changing with its latest innovations. In the

2007/2008 academic year, modifications were made from previous blocks. Starting from the 2013/2014 academic year until now, a new curriculum adapted to the competencies of Indonesian doctors has been implemented SKDI 2012 with integrated study programmes in blocks and PBL strategies (Pamungkasari, 2020).

In the Bachelor of Medicine stage, most Faculties of Medicine in Indonesia have several learning methods in the block system, namely tutorial discussions, practicum, lectures, and skills labs (Astuti et al., 2020). In addition, the Problem Based Learning-based integrated curriculum currently implemented by most Faculties of Medicine in Indonesia cuts the conventional physiology learning time including practicum, and includes it in the integration module (Rochmanti *et al*., 2019).

Table 1. Learning Physiology at the Faculty of Medicine in Indonesia

No.	Authors	Institution	Teaching Metode	Portion of Physiology Credits in the Curriculum (%)
1.	(Rochmanti *et al.*, 2019)	Faculty of Medicine, Universitas Airlangga	Hybrid (Taught by physiology department and integrated in other courses)	5/155 (3.22%)
2.	(Astuti *et al.*, 2020)	Faculty of Medicine, Universitas Brawijaya	Hybrid (Taught by physiology department and integrated in other courses)	4/148 (2.70%)
3.	(Kurikulum & Kompetensi Fakultas Kedokteran Universitas Indonesia, 2022)	Faculty of Medicine, Universitas Padjajaran	Integrated in a number of courses	0/144 (0%) Undefined
4.	(Undergraduate Study Program in Medicine, 2022)	Faculty of Medicine, Universitas Indonesia	Integrated in a number of courses	0/147 (0%) Undefined
5.	(Pamungkasari *et al.*, 2020)	Faculty of Medicine, Universitas Gadjah Mada	Integrated in a number of courses	0/156 (0%) Undefined

There are two variations in physiology teaching methods based on the curriculum of each medical faculty in Indonesia. Curriculum with hybrid method is a curriculum with a method of giving courses in a block system where basic preclinical courses are given separately in blocks based on departments and partly put together in integration blocks. Curriculum with integration method is a curriculum with a method of giving courses in a block system where all courses both preclinical and clinical are given in an integrated manner.

5. Medical Student Engagement in Physiology

Student engagement in understanding medical physiology is a fundamental aspect to form a deep and sustainable understanding of human body functions. Students' active participation in understanding physiology involves interactions that take place not only in the classroom, but also outside the classroom. The utilization of technology is key in enhancing this engagement as it has a very close role in the success of the learning process and effective understanding of the material (Brown *et al.,* 2017). The importance of engagement lies in the way students engage, participate and interact with physiology materials. Good engagement creates a more meaningful learning experience and improves students' ability to link theoretical concepts with practical applications in the context of medicine (Bawazeer *et al.*, 2023).

The role of lecturers in improving engagement in medical students has a significant impact on the success of learning, understanding of concepts, and development of skills required in medical practice. The learning process in medicine requires not only knowledge transfer, but also involves motivation, active engagement, and the development of professional attitudes (Tjakradidjaja *et al.,* 2016),

6. Increase Medical Student Engagement in Physiology

Quizzes are instruments that support the learning process of medical students. The role of quizzes in enhancing medical student engagement highlights their positive impact on student learning and active engagement in medical education. Quizzes are not only used as a traditional evaluation tool, but also as a dynamic learning strategy have emerged as a force that encourages student participation in medical learning. (Dengri *et al.,* 2021). The role of quizzes in the context of medical education is becoming increasingly significant in stimulating individual and collaborative learning among students. The interactive and dynamic nature of quizzes creates an engaging learning experience and helps maintain enthusiasm for the subject matter (Bhatkulkar *et al*., 2022).

Competitions are a stimulating and dynamic approach to complement formal medical education (Rudolphi-Solero *et al.,* 2021). The Indonesian Medical Physiology Oympiad (IMPhO) held in Indonesia is organised with an innovative quiz format that aims to simplify and increase enjoyment in understanding physiology science. This competition can foster participants' enthusiasm and motivation towards learning physiology (Istighfaricha, 2017). A similar competition, the Inter-Medical Physiology Olympiad (IMSPQ), offers students the opportunity to enhance their understanding of physiology through the medium of challenging questions along with live discussions with fellow participants. (Cheng and Hoe, 2016).

Medical student competitions in radiology have a role in creating a healthy competitive environment among medical students. RadiOlympic is a US national competition organised by medical students for medical students. The competition encourages students to continuously improve their knowledge in radiology and hone their interpretation skills. The competitive aspect of the competition can trigger collaboration and active discussion between students (Goodman *et al.,* 2023). In addition, the American medical student competition, SonoSlam, has a significant positive impact on the learning development of medical students. SonoSlam provides valuable experience for medical students to improve their understanding of a particular field. The competition not only serves as a competitive arena, but also has a very positive impact on the skills of medical students. Besides testing basic medical knowledge, the competition also trains students' skills in making decisions related to clinical management which has a high level of complexity. SonoSlam encourages students to apply their knowledge practically, stimulate creativity, and improve critical thinking patterns in the context of real clinical situations. Competitions such as SonoSlam prove to be an integral element in the formation of medical students who are not only academically competent, but also ready to face the challenges of a dynamic medical world (Boulger, 2019).

7. Conclusions

The teaching methods commonly applied in the current medical education curriculum are hybrid and integrated. Both have unique characteristics. Medical student competitions are one of the effective alternative learning methods outside of lectures. The role of lecturers and quizzes also have an important role in improving medical students' relationship to physiology. The curriculum of medical education in Indonesia, especially physiology courses, will probably continue to change and become a challenge for medical students along with the times. Therefore, medical students must be adaptive and have good learning strategies in studying physiology.

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