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Research Article

# ACTIVE LEARNING IN MEDICAL PHYSIOLOGY: A STUDENT-CENTERED APPROACH USING PHYSIOLOGICAL-PHYSICAL MODELS.

**Dr. Ganga Devi T.P[1]*, Dr. Madhuravani B[2]**

[1]Assistant Professor, Deportment of Physiology, Sri Lakshmi Narayana Institute of Medical Sciences, Puducherry 605502, India
[2]Assistant Professor, Konaseema Institute of Medical Sciences & Research Foundation, Amalapuram, Andhra Pradesh, India.

**ABSTRACT**
Since physiology is so complex and changes all the time, it is difficult to teach. Over the years, considerable learning about how students think and learn has developed which steers teachers to adopt more effective teaching techniques and value student active engagement in the classroom. The method described in this paper is constructed models approach, a student-centered approach appropriate for teaching physiology. After the physiology lectures and reviewing essential literature, the students worked in small groups to build relatively low-cost models that allowed them to work on physiology topics. All through this experience, teaching assistants and instructors regularly supported the groups which ended with each group making a presentation at the Integrative Physiology Symposium. Students successfully produced 118 physiological-physical models that clearly displayed how various physiological mechanisms function. The approach allowed students to try meaningful learning methods that met their individual needs. This method has been proven to make teaching and learning physiology interesting, reachable and simple, in line with current concerns about using experimental animals and new standards for training professionals. Encouraging students to take part in building knowledge may help them learn more and improve their job-related skills.

**Key words:-**Physiology education, Student-centeredlearning, Physical models, Active learning, Teaching methodology.

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## INTRODUCTION

It is a difficult undertaking to add new strategies to medical learning programs [1]. For many years, both cognitive research and the study of teaching-learning strategies have allowed educators to find out what works best in instruction. New research shows that becoming involved in activities helps improve memory and boost learning. These studies recommend using a variety of channels to provide information, since many suggest that successful teaching of physiology to students of various abilities and interests)involves both visual, aural and physical learning styles [6–11]. There are instructional methods designed specifically for physiology educators intending to discuss ethical animal research and to boost students' communication, thinking and teamwork abilities [16, 17]. When studying, models help us to recognize and handle complex topics by improving how we analyze and generate solutions. They support students in understanding

Corresponding Author
**Dr. Ganga Gayathri Devi T P**

the subject by giving them useful and memorable learning experiences [8, 19, 12, 2, 3, 14, 18]. Making physiology lessons more effective has become harder since changes to ethical rules and school curricula affect how experimental animals are used. Thus, our institution adopted a course plan using Problem-Based Learning (PBL) in its undergraduate program, so Physiology needed to adapt [3, 11, 20, 21]. As manipulative learning does not include animals and has shown benefits to students [7, 14], it was chosen as a promising way and formed the foundation of our teaching method. The article looks at how using physiological-physical models (PPMs) in the classroom can help with physiology lessons. Uniquely, in our approach, students are the focus, actively assembling their PPMs, rather than being told what to do, as all finished PPMs are featured during the Symposium on Integrative Physiology (SIP).

## METHODS

### Creation of the Teaching and Learning Strategy

The development of this teaching approach drew from the national health professional curriculum supplemented by the institution's undergraduate medical program policy. Other studies in physiology education were important sources for building our strategy's methodological framework, promoting team projects and information sharing and helping students move from basics to applying concepts practically in the field [6, 25]. This strategy was created using five key ideas: a) requiring no animals to be harmed in experiments, b) motivating student involvement, c) allowing students to learn through meaningful exercises, d) tailoring to different learning needs and e) preparing students for their future profession. All semester-long activities were logged systematically by the physiology instructor and PMs using logs for each student. At the end of the semester, the records were used to find evidence of my students absorbing and using the knowledge taught in IFL [9, 10]. The detailed methodology is shown in Figure 1 in sequence.

### Participants

In all, 512 undergraduate students in Human Physiology took part in the initiative. To organize the implementation, a group called Symposium on Integrative Physiology (SIP) was formed by registering four original students, who later became PMs from the first cohort after they were trained in the teaching-learning method. Besides, the students' work was also looked at by four guest faculty members in combination with the physiology instructor. From 2007 to 2010, no undergraduate human physiology students in the medical program needed Institutional Ethical Committee approval for their activities. This was allowed because every procedure was in line with the institution's Pedagogical Policy Plan and requirements for curriculum.

### A Protocol for Activities

In the beginning, the initiative was carried out in the classroom by including the teaching-learning method challenge in Physiology as part of the evaluation. Groups consisted of between three and five students. All groups were assigned or invited to pick a subject from the current module's physiology so they could choose which part of physiology to focus on. All throughout the term, each group spent an average of 16 hours turning their initial concepts into their final model. The protocol is shown in Figure 1 and included these steps: Students learned in lectures and were regularly advised on how to construct physiological-physical models. We met with instructors, project managers (PMs) and postgraduate students for two hours every week (Step 1, Figure 1). For their report, each group reviewed the relevant literature before explaining the physiological processes behind their PPM designs. It took around two hours to complete Step 2 (Figure 1). In PPM Construction, students built their projects using items that weren't from animals and they were able to team up with different university departments and outside organizations linked to what they were studying. In parallel, participants received instruction on using the scientific approach and making posters for the SIP. After completing the project, each group handed in a first abstract to the SIP Committee. Since the models differed in complexity, students needed from two to twelve hours to finish constructing them (Step 3, Figure 1). During the SIP, teams showed their models to audiences and talked about physiological ideas for 20 to 30 minutes per group (Step 4, Figure 1).

### Looking at the Products Students Make

We created a rubric from 0 to 10 points which looked at three main features: 1) originality, comparing the model with existing ones; 2) reproducibility, considering affordability and whether people can build it; and 3) how well the model represents physiological ideas. Members were assessed using the model, what they said during their presentation, what their posters showed and how they answered questions from the public (Figure 1). All of the authors took part in analyzing the data. As determined by the highest scores at SIP, some models were selected to act as examples of the topics discussed. Table 1 lists models chosen by voting and the agreement of all the authors.

## RESULTS

Presenting physiological-physical models at the Symposium on Integrative Physiology (SIP) brought novelty to the students' learning through active and total involvement. The students mentioned that trying different ideas and techniques before the final model was valuable for learning more and remembering the information. Moreover, this approach encouraged students to work together, as feedback indicated that they had enhanced skills in teamwork when exploring physiological concepts. Thanks to the SIP, students could seek academic awards

and find chances to have their research published which helped keep them interested in the program. Even though students enjoyed creating the models and giving presentations, they also realized that all the work pushed them hard over the semester and could at times be quite challenging because classes were very close together. It was tough for participants to fully interact with the student presentations because the symposium was only three hours long. Students learned a lot by joining in discussions and producing models with inexpensive and risk-free materials together. As they made explanations about their models and answered questions, students learned to think clearly and to communicate well. Developing, preparing and explaining their PPMs helped students learn actively, while involving them in constant reflection and change to their models developed their problem-solving and critical thinking skills. Participating in this extensive process, students learned more about the body and gained important attitudes and skills needed in their chosen careers.

**Table 1: Central ideas present in responses to the feedback questionnaire and their respective representative comments**

| Key Themes | Illustrative Comments |
|---|---|
| Building PPMs and participating in the SIP enhanced student learning. | "It's not just the finished model that educates, but the entire journey students experience while creating the model…" |
| The approach promoted essential skills like collaboration and teamwork. | "I participated in two symposiums. They greatly encourage creativity, allowing exploration of theoretical content and significantly improving teamwork abilities." |
| PPMs and the SIP provided additional benefits such as opportunities for publication. | "Presenting to an audience was very engaging, and as secondary outcomes, I received an Academic Excellence Award for my two models and potential publication opportunities." |
| Students enjoyed showcasing their models during the SIP. | "Creating a practical class model is a real challenge. The outcomes are generally excellent, and the presentation day is highly engaging." |
| The PPMs and SIP activities added considerable workload throughout the semester. | "These symposiums became quite demanding given the tight schedule of our course, although the symposium itself was dynamic, interesting, and highly educational." |
| Limited time during the SIP restricted students from fully viewing other groups' presentations. | "I studied intensively and learned effectively about my own topic… but I can't say the same about the other projects since there was very little time to visit the other groups' exhibits." |

**Table 2: Students' activities and their potential effects on the teaching-learning process.**

| Activities | Potential Impact on the Teaching-Learning Process |
|---|---|
| Engaging in discussions with peers and instructors about physiology concepts and the construction of models. | Deep Meaningful Learning |
| Constructing models by assembling inexpensive, inert, recycled materials that lack inherent physiological properties but collectively represent a physiological system or process. | |
| Formulating and articulating explanations about the physiological topic the model addresses and how it simulates the process. | |
| Responding to questions posed by fellow students and instructors regarding the model and the physiological phenomena it demonstrates. | |
| Taking responsibility for designing, preparing, and presenting a physiological-physical model (PPM) that illustrates a specific physiological mechanism. | Enhanced Active Learning |
| Participating actively in model construction, project documentation, presentation, and engaging with other creators during the Symposium on Integrative Physiology (SIP). | |
| Examining and comparing personal attitudes, values, and beliefs about learning when encountering differing perspectives within group collaborations. | |
| Continuously evaluating and refining ideas and concepts to improve model accuracy or address operational challenges. | |

## DISCUSSION

Here, a method is described that employs models to actively teach and strengthen learning in medical physiology. The main accomplishment was that students designed and made PPMs that accurately portray physiological systems. Since it was an integrated method,

students could easily transfer physiological ideas into simple daily uses. The complexity of building each model was connected to both its conceptual design and the materials used, as shown in Figure 3. Students were told to use things available around the house, trying to pick recycled or low-priced supplies. And yet, a few parts of these projects required the use of batteries or electronics which increased the difficulty of completing the projects. Although the level of difficulty varied, it became clear that students can design and build models of physiology without help if given suitable circumstances and so this approach may be valuable in other education institutions. Under ethical and legal reasons against animal experimentation, I made most models from recycled materials that are accessible and affordable. Fine industrial simulators for teaching physiology can be purchased, but those in developing countries may prefer to design their own. Symposium on Integrative Physiology (SIP) attendees found the PPMs to capture the main features of each topic well which helped stimulate group discussions and improve how students and teachers work together. Because the models were colorful, animated and made noises or even gave off smells or tastes, the audience was drawn in and remained eager to learn, as found in other similar programs. Many students said they found making Personal Project Management Processes to be truly helpful in their learning. The reports from students in the groups showed that using the protocol helped them acquire knowledge and build skills. Since students had to invent their own teaching models, they were encouraged to think in new ways that were different from the books or texts available. Students began by collaborating in groups and kept doing so throughout the program. This agrees with studies in education which point out that learners benefit more from cooperative environments. Teachers and monitors commented that students often handled topics by themselves in weekly group sessions, showing they were learning more and thinking more deeply with the help of their peers. for everyone. Conducting literature reviews while developing models helped students memorize more, learn to understand better and improve their learning skills. Using this method encourages students to stay interested in physiology and helps them learn related material which improves their grades. The results suggest that using a low-cost approach, focusing on students and adding problem-solving, clear explanation and group activities forms a helpful and feasible teaching method. Integrating topics from different areas into medical education leaves a natural question: how does this approach fit within busy physiology timelines? Because the method integrates various areas, it applies to physiology as well as to interdisciplinary lessons. Because students participate in out-of-class activities tied to the course such as the SIP, the method can be put into practice without adversely affecting main lessons. Groups worked on their modelsmultiple times, suggesting that constructing the models helps students clarify and improve their understanding of the organism's functions. Students practice active learning in the SIP by working with other models and learning with conversation. This type of involvement in learning is supported by research and is clear in our study as Table 2 demonstrates. In general, making physiology-related PPMs seems to involve forming multiple ways of thinking about the topic. In presenting models, students openly explained and confirmed what they understood about the body's processes. Engaging in hands-on work with the models at the SIP supported a variety of learning ways and helped us better remember what we learned. Incorporating various senses helps the method succeed with students studying physiology, since using different ways to present data is most effective for all learners. All of these results match past studies showing that teaching physiology through models offers better learning results than conventional approaches.

## CONCLUSION

In conclusion, the teaching-learning methodology described here demonstrated positive educational outcomes. This approach has proven to be an engaging and effective way to enhance the physiology learning experience. Additionally, the method is both accessible and relatively straightforward, promoting meaningful and active learning while accommodating diverse learning styles simultaneously.When considering this proposal in its entirety, certain factors merit attention, as noted in similar implementations [5, 15]. Firstly, physiology student populations are typically heterogeneous, encompassing a wide range of ages, cultural backgrounds, and educational experiences. Consequently, applying this activity protocol at different institutions may yield varied results. Secondly, our evaluations were limited to the period during which activities were conducted; longer-term assessments are needed to ascertain the durability of the knowledge gained, a matter our team is currently investigating. Finally, this teaching approach has not yet been directly compared to conventional methods. Although existing literature suggests that learning is enhanced in environments akin to the one we created, definitive evidence supporting our method would require comparative studies evaluating learning outcomes.

### Future Directions

Following the successful implementation of this approach, we plan to broaden its application to other health sciences disciplines by inviting additional faculty members to participate regularly. This expansion aims to establish an integrated symposium encompassing all biological and biomedical courses at our institution. A pilot project involving the Nutrition program has already been conducted in previous semesters. Through this

collaborative effort, we hope to extend the benefits of this methodology to more undergraduate health sciences programs, fostering shared experiences and collective learning that mirror professional teamwork after graduation. Furthermore, our team is developing an additional feedback instrument to further enhance evaluation processes.

**REFERENCES**


1. De Wit, H., Hunter, F., Howard, L., & Egron-Polak, E. (2015). Internationalisation of Higher Education. Brussels: European Parliament.
2. Gölkel, C., Wu, A., Chiuzan, C., Duong, J., Bernd, P., &Kielstein, H. (2019). Early internationalization of students in a German medical school in the former German Democratic Republic. *Annals of Anatomy = Anatomischer Anzeiger: Official Organ of The Anatomische Gesellschaft*.
3. Knipper, M., Baumann, A., Hofstetter, C., Korte, R., & Krawinkel, M. (2015). Internationalizing Medical Education: The Special Track Curriculum 'Global Health' at Justus Liebig University Giessen. *GMS Zeitschrift für medizinischeAusbildung*, 32(5), Doc52.
4. Majoor, G. D., &Willemstein, S. C. (1996). Internationalization of medical education. *Nederlandstijdschriftvoorgeneeskunde*, 140(2), 100–102.
5. Niemantsverdriet, S., Majoor, G. D., Van Der Vleuten, C. P. M., & Scherpbier, A. J. J. A. (2006). Internationalization of medical education in the Netherlands: State of affairs. *Medical Teacher*, 28(2), 187–189.
6. Stütz, A., Green, W., McAllister, L., & Eley, D. (2015). Preparing Medical Graduates for an Interconnected World: Current Practices and Future Possibilities for Internationalizing the Medical Curriculum in Different Contexts. *Journal of Studies in International Education*, 19(1), 28–45.
7. Koplan, J., Bond, T. C., Merson, M., Reddy, K. S., Rodriguez, M. H., &Sewankambo, N. K. (2009). Towards a common definition of global health. *Lancet*, 373.
8. Hanson, L. (2015). Internationalising the Curriculum in Health. In W. Green & C. Whitsed (Eds.), *Critical Perspectives on Internationalising the Curriculum in Disciplines*, 153–158. Springer.
9. Warner, G. (1992). Internationalization Models and the Role of the University. *International Education Magazine*, 8(1), 21.
10. Grudzen, C. R., & Legome, E. (2007). Loss of international medical experiences: Knowledge, attitudes, and skills at risk. *BMC Medical Education*, 7, 47.
11. Harden, R. M. (2006). International medical education and future directions: A global perspective. *Acad Med*, 81, S22–S29.
12. Battat, R., Seidman, G., & Chadi, N. (2010). Global health competencies and approaches in medical education: A literature review. *BMC Medical Education*, 10.
13. Peluso, M. J., Forrestel, A. K., Hafler, J. P., & Rohrbaugh, R. M. (2013). Structured global health programs in U.S. medical schools: A web-based review of certificates, tracks, and concentrations. *Acad Med*, 88(1), 124–130.
14. Ozturgut, O., Cantu, M., Pereira, L., & Krohn, D. (2014). Effective strategies in internationalization of higher education in the United States. Vol 32014.
15. Latifi, R., Dasho, E., Shatri, Z., et al. (2015). Telemedicine as an Innovative Model for Rebuilding Medical Systems in Developing Countries Through Multipartnership Collaboration: The Case of Albania. *Telemedicine & e-Health*, 21(6), 503–509.
16. Sherer, R., Dong, H., Yunfeng, Z., et al. (2013). Medical education reform in Wuhan University, China: A preliminary report of an international collaboration. *Teaching and Learning in Medicine*, 25(2), 148–154.
17. Arthur, M. A., Battat, R., & Brewer, T. F. (2011). Teaching the basics: Core competencies in global health. *Infectious Disease Clinics of North America*, 25(2), 347–358.
18. Holmes, D., Zayas, L. E., & Koyfman, A. (2012). Student objectives and learning experiences in a global health elective. *J Community Health*, 37(5), 927–934.
19. Izadnegahdar, R., Correia, S., Ohata, B., et al. (2008). Global health in Canadian medical education: Current practices and opportunities. *Acad Med*, 83(2), 192–198.
20. Khan, O. A., Guerrant, R., Sanders, J., et al. (2013). Global health education in U.S. medical schools. *BMC Medical Education*, 13(3).
21. Mews, C., Schuster, S., Vajda, C., et al. (2018). Cultural Competence and Global Health: Perspectives for Medical Education – Position paper of the GMA Committee on Cultural Competence and Global Health. *GMS Journal for Medical Education*, 35(3), Doc28.
22. Drain, P. K., Primack, A., Hunt, D. D., Fawzi, W. W., Holmes, K. K., & Gardner, P. (2007). Global health in medical education: A call for more training and opportunities. *Acad Med*, 82(3), 226–230.
23. Hayes, J. A., Ivanusic, J. J., le Roux, C. M., et al. (2011). Collaborative development of anatomy workshops for medical and dental students in Cambodia. *Anatomical Sciences Education*, 4(5), 280–284.

24. Strkalj, G., & Dayal, M. (2014). Working together, sharing resources: An interuniversity collaboration to advance anatomy education. *Anatomical Sciences Education*, 7(6), 501–502.
25. Elharram, M., Dinh, T., Lalande, A., Ge, S., Gao, S., & Noel, G. (2017). Global Health Values of a Multidirectional Near Peer Training Program in Surgery, Pathology, Anatomy, Research Methodology, and Medical Education for Haitian, Rwandan, and Canadian Medical Students. *Annals of Global Health*, 83(2), 274–280.
26. Murray, J. (2018). How Basic Science can Help to Inform Public Health and Improve Lives Globally. In *Foundation BaMG* (Ed.).
27. Wu, A., Kielstein, H., Sakurai, T., Noel, G., Viranta-Kovanen, S., Chien, C. L., & Bernd, P. (2019). Internationalization of Medical Education—Building a Program to Prepare Future Leaders in Healthcare. *Medical Sciences Education*.

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