Teaching Pathophysiology: Strategies to Enliven the Traditional Lecture

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This is a non-final version of an article published in final form in:

Van Horn, E.R., Hyde, Y.M., Tesh, A.S., & Kautz, D.D. (2014). Teaching pathophysiology: Strategies to enliven the traditional lecture. *Nurse Educator, 39*(1), 34-37. doi: 10.1097/01.NNE.0000437364.19090.be

Made available courtesy of Lippincott, Williams & Wilkins:
http://dx.doi.org/10.1097/01.NNE.0000437364.19090.be

Abstract:

The depth and breadth of pathophysiology content, foundational for nursing practice, is well suited for traditional lecture delivery. Use of creative strategies can deepen students' understanding while respecting students' diverse talents and ways of learning. The authors discuss strategies they used, including case studies, questions asked during lecture using immediate feedback technology, creative visual demonstrations, group pathophysiologic theory projects, short videos, and games, to enhance students' understanding and retention of content.

Keywords: Pathophysiology | Nursing education | Teaching methods

Article:

A thorough understanding of pathophysiology is foundational for nursing practice, whether content is taught as an independent course or integrated across a nursing curriculum. The American Association of Colleges of Nursing (AACN) Master's Essentials[1] include physiology/pathophysiology as 1 of 3 required content areas for master's degree programs that prepare graduates for roles in direct care, such as nurse practitioner or nurse anesthetist, as well as those who teach ADN, BSN, MSN, and DNP courses. The AACN *Essentials of Baccalaureate Education*[2] also note that an understanding of pathophysiology is needed to provide holistic, patient-centered care. Therefore, pathophysiology is a required part of both undergraduate and graduate nursing curricula.

Pathophysiology, whether at the undergraduate or graduate level, can be a daunting course for both students and faculty. This detail-intensive course integrates content from several areas, including anatomy, physiology, biology, and chemistry and uses this knowledge to build a

framework for understanding disease processes and the ways in which nurses can address the prevention, symptom management, and treatment of health conditions.

The depth and breadth of pathophysiology content make it well suited for traditional lecture delivery. However, 2 decades ago, King [3] suggested that college teachers should change their delivery methods from being the "sage on the stage" to becoming the "guide on the side." This change promotes student participation and discussion in the classroom and helps students relate new content to what they already know. Few articles address creative ways to teach pathophysiology.[4-9]

Our advanced pathophysiology courses, whether taught online or face-to-face, are based on the lecture format. Both in-person and online lectures are delivered in a "live" format using Blackboard "Collaborate" Web conferencing, a synchronous online classroom. We also offer students the option of watching the recorded Collaborate lecture and then posting their answers to questions revealed throughout the lecture to ensure that students are actually watching the recording and staying engaged. We incorporate PowerPoint handouts that encourage active participating. For example, when teaching about genetic inheritance of a disease or condition, students complete Punnett Squares during class. A Punnett Square is a diagram used to predict the risk of an offspring inheriting a disorder. Students are provided incomplete Punnett Squares in their PowerPoint handouts and complete them during class in small groups, followed by class discussion.

Recently, the traditional lecture format, although widely accepted, has been criticized for lack of effectiveness as a teaching method, because of a lack of student centeredness.[10-12] Isseks [10] has addressed several of the issues associated with this content delivery method, including oversimplification of content, lack of classroom discussion, false presumptions of what is and what is not essential content, students' mindless copying of lecture slides, and, of course, dark rooms that promote sleepiness. Despite these many criticisms, researchers have found that lecture, when enhanced with lecture notes, remains an effective method of teaching,[13] but most educators would agree that there is room to improve upon the traditional lecture format.[11,12,14,15] However, a recent study of 51 college students found that students believed they learned a great deal through lecture format and that they would retain the information learned. Furthermore, students felt engaged in the course, but did recognize that they were dependent on the instructor for their learning.[16]

Educational researchers have found that supplementing traditional lecture with interactive learning strategies improved students' learning and conceptual understanding.[11,17] Sorcinelli [18] also cites active learning strategies as a way to promote civility and decrease anonymity in classes. Thus, to increase active learning and student engagement, we supplement lectures with a number of strategies that can be adapted for online or face-to-face classroom formats. The following teaching strategies that we use promote student engagement in learning and are all compatible with traditional lecture format and multiple-choice testing (also

commonly used). The strategies also follow Chickering and Gamson's [19] 7 principles for good practice in collegiate education by (1) encouraging student-faculty contact, (2) encouraging cooperation among students, (3) encouraging active learning, (4) giving prompt feedback, (5) emphasizing time on task, (6) communicating high expectations, and (7) respecting diverse talents and ways of learning. Although the strategies have been used in our graduate course, they are also applicable to undergraduate pathophysiology courses.

Case Studies

Benner and colleagues [20] advocate avoiding the division of learning into separate clinical and classroom components and promote integration of the 2 to make the classroom a setting for rich experiential learning about clinical practice. The case study is an excellent way to merge classroom and clinical content by highlighting pathophysiology concepts through a patient story.[21] An effective case study not only increases the depth of understanding of complex concepts, but also enables students to translate pathophysiologic concepts in decisions about nursing practice. Case studies encourage students to consider sociological, developmental, and cultural aspects of health conditions and to pay attention to health disparity. Two examples include a case study of a child with a congenital heart disorder or a case study of an African American with high blood pressure and diabetes. Day [22] provides information on using the unfolding case study as a method for transforming traditional lecture courses into collaborative learning environments. We include a case study with every lecture. This case study may be discussed in class in small groups, in a "think, pair, share" format,[18] or as discussion with the entire class. For more on the "think, pair, share" technique, see http://serc.carleton.edu/introgeo/interactive/tpshare.html.

Case studies require students to incorporate underlying pathophysiologic processes, clinical manifestations, and rationales for treatments. Although medical treatment and nursing care are not the primary foci of the course, at times this content aids students in understanding the underlying pathophysiologic processes. Two examples include the pathophysiologic rationale for treating cancers with chemotherapy or the ways in which warfarin (Coumadin) and heparin affect different parts of the clotting cascade. Pathophysiology Case Study: Resting Membrane Potential, a sample case study, can been seen at Document, Supplemental Digital Content 1 (http://links.lww.com/NE/A117). The case study includes a brief description of a patient with congestive heart failure who has hypokalemia. Questions for the students encourage them to see why changes occur in the resting membrane potential and relate these changes to clinical manifestations. Case studies may be provided by the course textbook, found on the Internet or in the literature, or written by faculty. Case studies can be used effectively in face-to-face or online classes.

Questions During Lecture

Use of questions during lecture is an effective strategy to break up the content and give students an opportunity to immediately assess their understanding. Questions can be multiple choice, fill-in-the-blank, or true-false. One effective method of getting students to work together is the use of Immediate Feedback Assessment Technique (IFAT) forms, which its creators at Epstein Educational Enterprises (www.epsteineducation.com) describe as an interactive learning opportunity for students and an opportunity for spontaneous assessment of students for teachers. With IFAT forms, students are given a multiple-choice question and asked in small groups to choose the correct answer. They then scratch off the opaque film covering their selected answer, much like scratching a lottery ticket, to see if they chose the correct answer. Teachers collect the IFAT sheets at the end of class. In our experiences, students have enjoyed this group activity as a means of learning and applying course content. More on the IFAT technology, the psychological principles of the technique, a step-by-step demonstration of how IFAT works, testimonials, and opportunities to order the forms are available on the Epstein Educational Web site. Another creative in-class testing strategy is the use of "clickers," where individual students or small groups are able to enter the answer to a multiple-choice question. The product we use is a "Response Card" from Turning Technologies (www.turningtechnologies.com), which includes clickers (Response Cards) the size of a small calculator, the software to download the program, and a receiver the size of a thumb drive, to connect to the computer in the classroom. Turning Technologies offers a variety of other products that can be used to immediately assess understanding, enhance retention, and engage students in the classroom.

An alternative to using clicker technology, which has to be purchased, is Web polling with cell phones. Several Web sites offer online polling systems that can be accessed to create questions that students can answer by texting a number with their cell phone, or they can enter an answer using their computer through the Web site. One online polling site we have used is www.pollanywhere.com, which provides free polling to a limited number of participants (<50) and offers polling for larger numbers of participants for an enrollment fee. Poll questions can be created and stored in advance of classes and can be saved and used multiple times.

Visual Demonstrations

It has been said that a picture is worth a thousand words, and when discussing a complex process, sometimes a visual demonstration can save lengthy and tedious explanations. Visual demonstrations also can help students make connections that enhance their understanding and retention of content. Because these strategies are particularly helpful to students who are visual learners, we use several simple demonstrations to illustrate pathophysiology concepts in our course.

For example, a baseball and glove can be used to demonstrate the oxyhemoglobin dissociation curve, where the ball represents oxygen, and the educator represents hemoglobin. In a shift to the right, oxygen is released to tissues, and the educator throws the ball with the right hand. In a shift to the left, hemoglobin increases its affinity for oxygen, and the educator catches the ball in a

glove on the left hand. In this exercise, students are reminded that most baseball players throw a ball (release oxygen) with their right hand and catch a ball (increase affinity for binding oxygen) with their left.

The Frank-Starling law of the heart can be similarly demonstrated, using a rubber band. When the rubber band is stretched and released, it responds by flying a distance. As the band is stretched furthermore, it flies further away, just as the force of contraction of the heart muscle is increased with greater stretch. The limits of this phenomenon can also be discussed, as a rubber band that is overstretched will in time lose its elastic recoil ability, just as a heart muscle will lose some of its contractile function when chronically overstretched, for example, in congestive heart failure.

Similarly, chromosomal disorders of translocation, inversion, deletion, and duplication can be illustrated visually with strings of children's pop beads. For example, the large, brightly colored beads can be strung together to represent a chromosome, then a bead moved to illustrate a translocation, or one removed to show a deletion, or a series reversed to show an inversion.

Visual demonstrations can also be used to actively engage students in learning a multistep physiologic process. We use flashcards to teach the renin-angiotensin-aldosterone system (RAAS). Each student is given a 5 × 7 card with 1 component in the process written on it (kidney, renin, angiotensinogen, angiotensin I, etc). A diagram of the steps of the process is posted on the screen at the front of the classroom. Students are instructed to find the step in the process on their flashcard and the step immediately preceding it. The steps in the RAAS process are cited aloud as the students hold their card up at the appropriate time and read it to the class. The educator facilitates the exercise and corrects students if they jump in too early with their card. After reciting the entire process, students are asked to give their card to a student without a card, and the process is repeated.

For the 3rd recitation, the diagram is removed. The class is often able to recite the entire process from memory. Our experiences with this exercise have been positive, with students actively participating and stating that they found it an enjoyable and effective method for learning this complex process. In convened classes, students can actually get up out of their chairs and arrange themselves to represent a series of sequential steps. For example, each student could be given a card representing a step in the clotting cascade, and they could physically arrange themselves to show the intrinsic and extrinsic pathways. These strategies are particularly helpful for kinesthetic learners.

Another example of a visual demonstration is the use of a sponge to illustrate heart filling and heart contraction. When the heart contracts, the sponge is squeezed, preventing any blood (water) from filling the heart. When the heart is relaxed, then it can fill, just like a sponge can then fill with water. The sponge analogy is easy for students to visualize.

Group Projects

Students complete 2 small-group projects during a semester.

Theory Project

In the theory project, students choose a pathophysiology theory for which there is both supporting and refuting evidence. We encourage students to explore theories that have received attention in the media on the controversial causes of diseases, such as vaccines and Autism, vitamin D deficiency and multiple sclerosis, or aluminum and Alzheimer's disease. Or they may look at theoretical support for a treatment or preventive measure, for example, the cow's milk diet to reduce weight, circumcision to prevent sexually transmitted diseases, moderate hypothermia after cardiac arrest to reduce neurological damage, or the ketogenic diet to treat epilepsy. These theory projects require students to apply concepts from the course, and they show students that there are many things that are unknown about cellular and body processes. We believe this is essential, because all pathophysiology texts present content as if it is "fact," and they rarely cite research to back up the content. In addition, the students come to understand the strong link between genetic and environmental influences on diseases, and often they explore the links among the pathophysiology behind a disease, its proposed etiology, and/or the proposed rationale for treatments. We require students to present both "supporting" and "refuting" evidence for the theory, and thus students learn from the research on theoretical approaches to pathophysiology. As part of the project, each group writes test questions for the content that all students in the class must answer in homework exercises. These test questions engage interest in their classmates' projects.

Educational Pamphlet Project

For the educational pamphlet projects, small groups review the pathophysiology, etiology, clinical manifestations, and treatments of a disorder or the rationale for a treatment for a disorder and are instructed to explain the pathophysiologic concepts in lay terminology (no higher than 7th-grade reading level). This project requires students to take large amounts of content and prioritize and edit it down to essential information. Each group identifies a target audience for education (eg, patients, families of patients, or the public at large), and the group tailors the content to their selected audience. As with the theory project, students write test questions for the content that all students in the class are required to answer. Students frequently develop a pamphlet that they then use in clinical practice to educate patients and families about a disorder or treatment.

Short Videos

We have found that diagrams alone are not always helpful for understanding some of the more difficult pathophysiologic processes. Therefore, we have collaborated with The University of North Carolina at Greensboro, Division of Continual Learning, to create 7 short animated videos to illustrate these concepts: (1) pressures affecting the capillary wall, (2) the nephron and renal disorders, (3) the oxygen-hemoglobin dissociation curve, (4) the renin angiotensin-aldosterone

system, (5) nociception and pain, (6) inflammation versus immunity, and (7) liver disease: the effects of portal hypertension and hepatocyte failure. These videos are 1 to 2 minutes in length and are shown in class and posted to the course Web site. Students are also encouraged to watch them before class to enhance their understanding of lecture. The video on liver disease can be viewed athttp://youtu.be/sGvQzhaczkQ.

In addition to creating videos for the course, a multitude of videos are available on the Internet, with many available on YouTube at no cost. Videos are particularly helpful in presenting clinical symptoms, such as the shuffling gait and tremor associated with Parkinson's disease. Animated videos are especially suitable for illustrating cellular processes (eg, the sodium-potassium pump or nerve cell transmission) or physiologic processes (eg, the baroreceptor reflex response). These are important for students who are primarily visual learners.

Games

Royse and Newton [23] have reviewed the literature on gaming as a strategy for nursing education. They concluded that gaming is an effective educational strategy for improving knowledge retention and problem solving and for enhancing student engagement in learning. In our graduate pathophysiology course, we limit the use of gaming to the last lecture, in which we use a Jeopardy game to provide a comprehensive review for the final examination. The game is an excellent way to review a range of important course concepts from the entire semester in a relaxing and fun format that adds to student investment in learning. We use small prizes such as party favors, candy, or emoticons (for online classes) as a motivator for active participation. Students are divided into groups, and they get excited and engaged with the competition.

Homework Sets

Students' grades in our pathophysiology courses are derived from a combination of group work (such as the theory and pamphlets projects) and individual work (such as homework assignments and timed, closed-book tests). In the tests, we present questions that require the application of knowledge, not just recall and recognition of facts. Many of the test questions are essentially short case studies. To prepare students for these tests, which they say are quite different from the recall/recognition level multiple-choice tests in other courses, we give students extensive homework problem sets. These homework sets ask questions similar to those on the tests—in fact, some homework questions are items from prior tests that have been "retired" for reasons of test security. However, the homework sets are take-home, open book, and not timed. Each student must submit his/her answers individually, but students are encouraged to collaborate on and discuss the homework items. Because the homework sets are open book, untimed, and collaborative, we assign a small percentage of the class grade to each homework assignment. However, the students find them very beneficial in preparing for the tests. Nursing is a profession in which the practice is best conducted in a collaborative manner, and the

collaborative assignments in this course foster students' abilities to work as a team and to learn from each other.

Conclusion

Pathophysiology is foundational content for nursing practice at both undergraduate and graduate levels. Traditional lecture is an effective method for helping students focus on the core concepts of pathophysiology needed for nursing practice. We use case studies, immediate feedback techniques, visual demonstrations, group projects, short videos, games, and homework sets to enhance the traditional lecture format and to enhance students' understanding and retention of content. We have found these strategies effective in moving the educator from center stage to the guide on the side,[3] in providing opportunities for students with a variety of learning styles, and in promoting the integration of classroom and clinical learning, as advocated by Benner and colleagues.[20]

Acknowledgments

The authors gratefully acknowledge the editorial assistance and inspiration from Elizabeth Tornquist, MA, FAAN, and the assistance of Mrs Dawn Wyrick.

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