



Using and Combining Learning Theories in Medical Education

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Abstract

Medical education needs to be well informed by learning theories, and preferably more than one theory. Medical teachers need to be familiar with a range of learning theories and should be able to critique them in ways that allow us to combine good ideas from one theory with good ideas from other theories. This can give our teaching real depth and help us avoid common pitfalls that arise from misapplying a theory due to a superficial understanding. We provide an example where a number of learning theories were usefully combined.

Keywords Learning theory · Threshold concepts · Dialogism · Narrative · Constructivism

A great deal of medical education is still done by teachers simply repeating the way in which they were taught. Others may simplistically try to follow the latest trend, such as competency-based education or flipped classrooms. We argue that medical educators need a deeper and more critical understanding of the educational theories they are using. Without a deeper understanding of theory, there is a serious risk that innovative teaching will be misapplied with poor results and end up being rejected by both students and teachers. The rejection may be justified by the simplistic claim that “it just doesn’t work” when the reality may be that it was never properly understood or applied in the first place. For example, problem-based learning works well when a facilitator encourages the student group to identify knowledge gaps that lead to self-directed learning. Too often the facilitator may stop facilitating and start didactic teaching [12]. It may also be that some learning theories are inappropriate in some situations. We avoided behaviorism, as it focuses on outward performance only and ignores understanding (or misunderstanding). In this setting, we wanted students to articulate their understanding of the topic and not just demonstrate factual recall.

Understanding an educational theory allows us to apply it as designed. Understanding also permits us to critically apply a theory with subtlety and appreciate the many important small “tweaks” that may be needed to adapt an approach to local circumstances. Such subtle changes can change a learning experience from routine to memorable. In such cases, the theory really does inform the teaching. Informed teaching can, in turn, help refine the theory. If teachers have a deeper understanding of several educational theories, then they may see connections between those theories. The ability to critically connect separate theories can then enable teachers to combine, and apply, those theories in creative ways to produce teaching and learning interventions that really are innovative, robust, and more likely to succeed. In this commentary, we use an example where several theories were used to inform an educational intervention. These theories include constructivism, threshold concepts, narrative medicine, dialogism, and active learning. We also outline how these ideas align with each other.

Constructivism

Constructivism, briefly, is the idea that, as learners, we cannot simply absorb knowledge from the world around us. Learners must actively construct their knowledge and understanding [11]. Conversely, as teachers, we cannot simply expect to transmit information to learners and assume they will understand it in exactly the same way that we do. In a constructivist view, the learners have to make their own understanding. As

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teachers, our aim is to guide that construction. The problem of course is that our learners may get it wrong. This raises the issue of how we can find out what their misunderstandings are and how we can help students to construct concepts and understand them in the ways we want. This leads us into another theory, that of threshold concepts.

Threshold Concepts

Threshold concepts (sometimes referred to as threshold theory) have been generating considerable interest in higher education for some years [5]. They have recently started to have more impact on thinking in medical education [6]. In threshold theory, there is an assumption that there are certain key ideas that are crucial to understanding a discipline and that if students do not truly understand these ideas then they can never have a real grasp of what the discipline entails. An early example in higher education was the work that was done in physics and engineering in which teachers discovered that their students did not really understand basic concepts such as momentum [7]. What was alarming about this work was that the same students were able to pass exams and graduate. Nobody (students or teachers) realized the level of misunderstanding that remained until the research was done. The students had succeeded in mimicking understanding and the formal course assessments had failed to pick this up. Threshold concepts are an attempt to delineate these key ideas so that students and teachers can focus on them. Threshold concepts have now been described in many disciplines and have certain characteristics.

They are transformational and irreversible in that once they are understood, then one's understanding of a discipline is changed dramatically and changed forever. There is no going back. It could be argued that in the biomedical sciences the concept of homeostasis is an example of a threshold concept that underpins nearly all of human biology. It is transformational. Once you understand homeostasis and its implications then your understanding of human biology can never be the same again. The biomedical sciences are then opened up to a deeper understanding that cannot be available to someone who does not really see how or why homeostasis is important. Threshold concepts are integrative in that they allow us to see connections with other sub-fields. Once we realize that homeostasis is widespread, then we can more easily see how it permeates, and helps us to make sense of, subjects as diverse as endocrinology and genetics. Threshold concepts are also described as troublesome in that they may be counter-intuitive and it may take some time and effort for students to fully grasp them. These characteristics have implications for the design of curriculum and pedagogy. We can focus on the threshold concepts and work with students to come to an understanding of these. We do not have to cram every possible detail of a topic

into a teaching session. We can also assume that the students will be able to fill in the details for themselves once they have a grasp of these key ideas. In the example we give below, the threshold concept was homeostasis as it applies to the activity of the thyroid gland. Another theory that informed the teaching was narrative.

Narrative

Narrative inquiry, and its close cousin Narrative Medicine, assumes that humans learn naturally through storytelling. It can be argued that we are narrative creatures and grow up telling and listening to stories [8]. The field of Narrative Medicine has, for example, provided a useful way of opening up our understanding of clinical reasoning as we realize that the task of reaching a diagnosis and treatment plan is largely narrative in nature [9]. A doctor will typically take a patient's complaint of an illness or injury and, using biomedical knowledge, transform the patient's story into the story of a clinical case based upon pathophysiology. The doctor's version of the story will usually have a narrative trajectory into the future where the appropriate treatment will, hopefully, allow the story to reach a happy ending typified by a cure. Narrative Medicine has made great strides in helping us to a better understanding of clinical practice and education in recent years [2] but there is scope to apply it in teaching in the preclinical years. Instead of delivering masses of detail to students, we can tell a story built on the threshold concepts we want to teach. In our example, we told the "story" of the thyroid gland and how it works to maintain homeostasis. To apply a narrative approach to teaching, we need to answer key questions, such as who, what, where, when, and why? What is the storyline? How will it start, develop, and end? In our example, the main "characters" were the thyroid metabolic hormones, triiodothyronine (T_3), and thyroxine (T_4). The story started and ended in the pituitary gland with thyroid-stimulating hormone. The next theory we used to inform our teaching was dialogism.

Dialogism

Dialogism emphasizes the importance of relationships [1]. In this theory, dialog is a metaphor for drawing attention to how relationships are established and maintained. There are important educational relationships between teachers and students and also between students and the material to be learned. A dialogical approach in education emphasizes that what students learn, and how students learn, depends entirely on the relationships they develop, both with the teacher and the material they are trying to master. It is all too easy to overwhelm students with too much detail and force them into superficial

relationships with subjects where they simply try and memorize those details for an exam, with no real depth of understanding. To apply dialogism to teaching means paying explicit attention to how we help students develop meaningful relationships with the subject we are teaching. With a dialogical approach, we need to think through answers to the following questions. How do we encourage students to relate to, and work with, the subject matter? How does the teacher relate to the students? Are there learning activities where the students help each other learn? The final theory we used was active learning.

Active Learning

Active learning assumes the importance of teaching and learning activities that compel students to work with and process the subject material, rather than simply receive it in a passive manner. A well-known example is the flipped classroom where there is an emphasis on student activity throughout the class. We are not advocating that lectures be completely abandoned for the flipped classroom, but we are encouraging teachers to include at least some short activities in a teaching session where students must actively engage with the teacher, with the material and with each other. A well-known example is the peer-to-peer teaching recommended by Eric Mazur [10] who pioneered the i-clicker. He pioneered this device so that he could compel engagement from a large class of students.

Mazur also put a lot of thought into providing short activities that took only a couple of minutes each. The activities compelled the students to try and answer a difficult question that only about half the class would answer correctly. They then had to discuss their answer with someone who had a different answer. The students then had a second chance to select an answer. Mazur found that several goals were fulfilled at once. The students had to actively engage with, and think through, the material to come up with a preliminary answer. They then had to discuss their answer with someone else and persuade them to change their mind, or allow themselves to be persuaded to change their original opinion. In other words, the students were teaching each other. The selection of the question and the student responses allowed the teacher to find out what the major misunderstandings were so that these could be directly and immediately addressed. In our own example, there were plenty of opportunities for full class discussion and our evaluations later showed that the students did learn from what other students said and how they said it. The practical details of our teaching intervention were not complex and could be easily applied by any teacher in the biomedical sciences.

The Intervention

Students were supplied with copies of the thyroid gland physiology PowerPoint slides several days before the lecture and directed to come to class prepared to discuss the content. The lecture itself was delivered using an interactive, narrative approach. The interactions followed a storytelling format that incorporated simple questions and answers at regular intervals using a version of the PowerPoint slides prepared specifically for that purpose. Examples of how the theories influenced the lecture and its interactions include the following. An early set of questions asked the narrative questions who, where, what, and how. Who were the main “characters”? In this instance they were the T3 and T4 hormones. Where was the action occurring? It was occurring in the cells of the thyroid gland. What was happening and how? The students were prompted to provide the details such as the iodination of the hormones and their transport into the follicle of the gland. The hypothalamo-pituitary-thyroid axis also provided a narrative structure for much of the rest of the lecture. Dialogism, with its emphasis on meaningful relationships, provided the inspiration for later questions that compared and contrasted thyroid hormones with growth hormone and cortisol. The interactions allowed misunderstandings to emerge. For example, several students missed the significance of the thyroid receptor being in the nucleus of cells and this became apparent during one of the question and answer interactions. The final part of the lecture was devoted to clinical conditions and the importance of homeostasis, a threshold concept, in a discussion of iodine deficiency. The students were encouraged to comment on and build upon the answers of other students. Following the session, a preliminary study was conducted to evaluate the learners’ perceptions by using both questionnaire and focus groups [4]. Feedback was very positive with comments such as the following:

I think engaging is the best way to describe this, compared to other lectures. It’s a lot easier to pay attention and follow because of the interactive atmosphere.

It gets you listening and thinking in a way that you’re not used to. It makes you question what other people are saying.

Discussion

It is important to be clear how different theories can relate to each other, how they align, and how they may complement or contradict one another. A useful starting point is the four-level hierarchy advocated by Crotty [3]. Crotty’s first level is epistemology, our underlying philosophy of how knowledge is

acquired. In our case, the epistemology was constructivism. Building on epistemology is our theoretical perspective. In our example, we used narrative, dialogism, and threshold theory together. Crotty's next level is methodology. This is the overall strategy underpinning the methods used. Our methodology was active learning. Crotty's fourth and final level relates to the actual methods used. In our case, this was interactive teaching embedded within a didactic lecture.

The main point we wish to make is that by aligning the different theoretical levels and combining insights from several educational theories, we were able to come up with a teaching/learning design that had real theoretical depth and allowed us to analyze what needed to happen, and what did happen, and how we can improve it in the future. For example, the experience emphasized for us the importance of providing a safe space where students can articulate what turn out to be misconceptions and gaps in their knowledge. Some students admitted that they had certain key ideas wrong or that they had missed certain key details. The main threshold concept driving the lecture was homeostasis as it applies to thyroid regulation. We believed that as long as students grasped the self-regulatory mechanisms that interact to maintain thyroid function, then they would be able to work out many of the details for themselves without being told by the teacher. While this was largely true, some of the misunderstandings did not emerge until the class interactions. Without this chance to correct misunderstandings, these students would have continued oblivious to the fact that they did misunderstand. We believe that students are also much more likely to remember both the principles and the details as they work with them individually, with the teacher, and together with other students. It was possible for other students to identify misunderstandings and help their classmates without being totally reliant on the teacher. This does, of course, require that the teacher works hard to provide a safe environment for class interaction where misunderstandings can be articulated without fear of humiliation.

The different hormones were also seen as the main characters in the ongoing story of the thyroid system. By following a narrative format, the intention was to help students see the ways in which the activity of one hormone naturally and logically led into the activity of another part of the thyroid system. They were then also in a better position to work out the consequences of dysfunction in the thyroid system and the clinical implications. We argue that a narrative overview allows the interconnections of the thyroid system to be easily visualized and more easily remembered. A key aspect of the narrative is the system of relationships between the different parts of the thyroid system and this returns us to the dialogical view.

Placing an emphasis on the relationships within the thyroid system, and how they adjust to change, helps students work through the mass of details to grasp the key ideas. Relationships between people were also a key to

understanding the class interactions. Students realized that they were able to learn from hearing their peers express ideas. This gave them a sense of how well their peers understood something and how well they themselves had understood or misunderstood something.

In combining these different theories in a rigorous manner, we, as teachers, have come to a deeper understanding of what can be happening in the complexities of interactive teaching. All the theories mentioned provided us with insights into how we can make sense of classroom activity. The theories all align with each other at the different epistemological levels described by Crotty [3]. We have found that this approach has provided us with a robust sense of direction, both in designing the learning activities, and in reflecting on what happened and how we can improve for the future.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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