Constructivist Learning Theory in Problem-based Veterinary Medical Education

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Abstract

Problem-based learning is an evolving pedagogy in veterinary medical education. Benefits for students include the development of problem solving skills, clinical reasoning skills, and a sense of responsibility for their education. Inherent in the problem-based learning pedagogy is the Constructivist Learning Method, in which students gather together to work through a problem, make sense of the details of the case, construct plans or solutions, and end with identifying issues for further learning. Also, constructivism implies that new knowledge is continuously built on a base of previously gained knowledge, obtained in previous experiences, or in educational exercises such as lectures and laboratories. The faculty tutor, through constructivism, is a major part of the facilitation of discussions in problem-based learning.

Introduction

Over the last 15-20 years, many colleges of veterinary medicine have changed their curricula to reflect the evolving views of desired learning outcomes. Problem-based learning (PBL) has been attributed to promote life-long learning skills, as well as skills in self-directed study, clinical reasoning, problem solving, information management and interpersonal communication skills (Herron, Whitney, and Weeks, 1994). Educators and administrators have argued that the problem-based learning format may be superior to the conventional lecture based didactic curricula for the development of such skills (Lane, 2008). Somewhat implied but not previously examined is the inclusion of the constructivist learning model in veterinary programs, and the benefits of the implementation of constructivism in the PBL pedagogy.

The goal of this article is to describe how the Constructivist Learning Method is embedded into PBL pedagogy in veterinary medical education, and how constructivism can impact student success in veterinary medical education, and to provide an impetus to encourage the inclusion of constructivism within other professional curricula.

Overview of the Problem-based Learning Pedagogy in Veterinary Medical Education

Problem-based Learning is any learning environment in which the problem drives the learning. Before students learn any pertinent information about a topic, they are presented with a problem. The problem is presented in a manner such that students gain knowledge as they search out information needed to solve the problem. The problem is purposefully open-ended, to allow the students flexibility in working through the problem, and gaining knowledge in the process. By posing the problem at the beginning of a unit, students realize why they are learning the new information. Learning in the context of a problem that needs solving stores knowledge in memory patterns that facilitate later recall for solving problems. In PBL formats in medical and veterinary medical education, the central focus is on medical and biologic problems. In many of these programs, the primary PBL instructional method is the interactive tutorial group supplemented with some didactic or structured presentations, laboratory activities, and other hands-on exercises such as learning physical examination techniques, taking histories, and shadowing professionals. Many instructors have found interactive tutorial groups to be very well received by incoming first-year veterinary students, and their enthusiasm is reflected in their participation and success in this curriculum.

The typical tutorial group consists of approximately six students and one faculty tutor. The faculty tutor is not present to lecture to the students, or to provide answers that give away information and knowledge that the students are meant to find on their own. Instead, the faculty tutor is present in the tutorial groups to facilitate discussion, keep the discussion on track, provide insight and background when necessary to keep the discussion going, and to aid in resolving intra-group conflict. The PBL format can be used in a class with a large number of students, as the students are divided into smaller tutorial groups. Each tutorial group meets two to three times per week, with each session lasting 2-3 hours. In the PBL format, at the beginning of a unit, a new problem is presented to each tutorial group. In veterinary medical programs, these problems are

in the form of a clinical case involving an animal patient. During their reading and discussion of the clinical case, the students analyze the loosely-structured case in specific ways with the guidance of their faculty tutor. Facts are listed, questions are posed, hypotheses are theorized, and a plan is generated. Through these discussions, a list of learning issues would be generated. These learning issues are topics that need further independent or group study at a later time, after the tutorial session. For example, a learning issue might be a more detailed study of the disease from the case, or the physiologic processes that the affected organ system performs. Other learning issues may include topics from other disciplines that include information that integrate with previous learning issues, such as the pharmacology and biochemistry of medications that affect the physiologic mechanisms, or how to perform a procedure, or what ethics need to be considered.

Example of a Case in Problem-based Learning

An example of a case in the PBL pedagogy might be a dog that had been hit by a car and has trouble breathing. That may be the only information first offered as an open-ended problem, and the initial facts that are listed are: dog, hit by car, and trouble breathing. Questions that may be asked by the students of the group may include: "What body region of the dog was hit?", "What does 'trouble breathing' mean?", "What anatomic structures are involved in breathing?", and "What respiratory structures may be affected to cause trouble breathing?"

Hypotheses that may arise from this initial information might include: Collapsed lung, lacerated trachea, fractured ribs, and pneumothorax (air or gas trapped between the lung and the chest wall). Veterinary students in the tutorial group may then propose a plan that may include: listening to the lungs via stethoscope, providing oxygen by a mask, and obtaining radiographs to further diagnose the condition. During the PBL tutorial group, the case may proceed, with more information provided that may answer the previously asked questions. A radiograph may reveal that there was indeed a pneumothorax, which would indicate that air should be removed from the chest cavity

outside the lung to ease the pressure on the lungs. More questions would follow, such as “How does one perform the procedure to remove air from around the lung and what is it called?”, and “What are the anatomic structures that are involved in this procedure?”

At the end of the PBL tutorial group session, the group would develop learning issues for further learning outside of the group. Examples thus far in this case may be:

- The pathway of air from the outside down to the microscopic area of oxygen diffusion;
- The number of lobes in the lung and their arrangement in the chest cavity;
- The tissue layers passed through during removal of air from the chest;
- Normal radiographic anatomy of the chest, including the heart and lungs.

Students could get the information to resolve these learning issues via other activities in the course specifically structured and scheduled around the PBL case. After the tutorial group, one such activity would be gross anatomy dissection laboratory, in which students would discover the lobe numbers of the lung and how they are situated in the chest. Another activity would be a radiology lab to discuss normal radiographic anatomy of the chest. Also, students may attend a lab session working with live dogs, practicing techniques to properly listen to the lungs.

At the subsequent sessions of the tutorial group, the students would come together to further discuss the previous session’s learning issues, bringing in information obtained from the other activities, and from students’ own readings and previous experiences. This would continue until the case ended and all learning issues discussed sufficiently to satisfy all members of the group. By proceeding through the case, discussing it with others, obtaining more information outside of the group session, and bringing in previous knowledge and experience, students build their knowledge via the constructivist theory.

Veterinary PBL Pedagogy and the Constructivist Learning Theory

PBL in veterinary medical education as described above includes many concepts prescribed by the constructivist learning theory. In defining "constructivist" learning environments, Wilson (1996) explains: "A learning environment is a place where people can draw upon resources to make sense out of things and construct meaningful solutions to problems. Adding ‘constructivist’ to the front end of the term is a way of emphasizing the importance of meaningful, authentic activities that help the learner to construct understandings and develop skills relevant to solving problems". This constructivist learning environment within the PBL pedagogical curriculum is the tutorial group, in which students gather together to work through a problem, make sense of the details of the case, construct a plan or solution, and end with creating additional learning issues. It is very apparent that constructivism exists within the tutorial group to help the learner develop comprehension of material via problem solving in the context of a clinical case.

Another way to see that constructivism is embedded within the PBL pedagogy is the concept of constructivism in which students use previous knowledge and experience to construct new knowledge, either by building on previous knowledge, or by replacing previous knowledge with more correct, accurate, or current knowledge of that topic. As Kaufman (2003) states, the primary idea of constructivism is that learners “construct” their own knowledge on the basis of what they already know. This theory posits that learning is active, rather than passive, with learners making judgments about when and how to modify their knowledge.

For example, in veterinary medical education, students are encouraged and/or required to spend a significant amount of time in a veterinary clinical setting, prior to attending veterinary school. In this experience, students participate in veterinary activities through which they gain knowledge, either from their own observations or through explanations from their mentors. These students then attend veterinary school, and in the PBL tutor group, this previous clinical experience and knowledge becomes a rich resource for

learning, as they reflect on the clinical cases they have previously observed. In these situations, students can further construct knowledge based on their previous knowledge, or correct any inaccuracies in knowledge from their previous experience. This previous experience and knowledge has given many veterinary students an advantage in the PBL pedagogy through this constructivist approach by allowing them to build knowledge based on what they already know.

Constructivism not only pertains to learning by the students, but also deals with how instructors interact with students. This happens in four ways:

1. Kaufman (2003) states that the teacher is viewed not as a transmitter of knowledge but as a guide who facilitates learning. This is consistent with the faculty tutor in the veterinary PBL pedagogy as a facilitator of discussion.
2. As learning is based on prior knowledge, teachers should provide learning experiences that expose inconsistencies between students' current understandings and their new experiences. The tutors in the veterinary PBL pedagogy are well-versed in the cases that are presented to the students, including the clinical aspects of the case as well as the basic science information and processes behind the clinical aspects. The faculty tutors, via constructivism, can help students identify inaccuracies and inconsistencies in their knowledge.
3. Teachers should engage students in their learning in an active way, using relevant problems and group interaction. This is the heart of the PBL pedagogical curriculum in veterinary medical education. As stated previously, small group discussions revolve around using relevant clinical cases to provide the impetus for acquiring basic science content knowledge.
4. If new knowledge is to be actively acquired, sufficient time must be provided for in-depth examination of new experiences. Instructors using the constructivist learning method help students analyze facts and come to a new understanding of the subject matter by providing opportunities for discussion and critical thought. The tutor in the veterinary PBL pedagogy has experience in facilitating further

detailed discussion on new information acquired by the students, after individual research of students' learning issues.

Conclusion

Many colleges of veterinary medicine are choosing to implement the PBL pedagogy within their curricula because of the colleges' goals to develop a program that will help develop a veterinarian able to solve real-world problems by integrating knowledge and skills that encompass a "complete" graduate, and a contributing citizen of the community and veterinary profession. Developing PBL has been a way to achieve such a goal. At the root of the PBL pedagogy is the constructivist learning model, which allows for the construction of new knowledge as well as building on previous knowledge. In addition, constructivism encourages interaction between teacher and student that leads to relevant acquisition and comprehension of the subject matter. It can be seen that PBL in a veterinary medical education is an effective pedagogy that can often employ constructivist theory to achieve its curricular and pedagogical goals. It does this by fostering a self-directed learning environment, and drawing upon and building on students' own past and current experiences. Because of the perceived benefits of PBL and constructivism, more colleges of veterinary medicine are providing these types of learning environments for their students.

References

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