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Teaching and Learning Portfolio

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Introduction to the Delta Program

Mission
The Delta Program in Research, Teaching and Learning promotes the development of a future national faculty in the natural and social sciences, engineering, and mathematics that is committed to implementing and advancing effective teaching practices for diverse student audiences as part of their professional careers.

Delta Pillars
The Delta Program is founded on three interrelated core ideas: the Teaching-as-Research approach is explored via Learning Community opportunities that are based on Learning-through-Diversity. These ideas (pillars) are the foundation of the Center for the Integration of Research, Teaching, and Learning (CIRTL), a national project and network of which Delta is a founding member.

Teaching-as-Research
By applying research methods—idea, experiment, observation, analysis, improvement—to the challenge of teaching, the Delta Program:

• Brings the skills of research faculty to the ongoing investigation of student learning
• Promotes innovation in teaching and measurement of student learning
• Advances the role of instructors in the ongoing improvement of teaching practices

Learning Communities
Through collaborative activities and programs, the Delta Program creates a community of graduate students, postdoctoral researchers, and faculty that will:

• Support and validate growth in teaching and learning
• Create a foundation for institutional change

Learning-through-Diversity
Recognizing the common challenges in teaching and learning and the strength in bringing together diverse views, the Delta Program is:

• Interdisciplinary—serving science, engineering, mathematics, and other departments
• Cross-generational—bringing together graduate students, postdocs, and both new and experienced faculty
• Comprehensive—providing knowledge, practice, and community
• Responsive—reflecting the broad range of responsibilities that face today's faculty
• Inclusive—welcoming for a multifaceted and diverse group of people
A Note on Veterinary Medical Education

My teaching experiences are somewhat different from my fellow graduate student participants in the Delta program. While they work primarily with undergraduates, I work primarily with veterinary medical students. As such, I often find myself explaining certain aspects of veterinary medical education to my colleagues in Delta courses so they can better understand the work I am presenting. Therefore, in order to facilitate evaluation of this portfolio by non-veterinary readers, I have provided a short timeline of veterinary medical training:

The Doctor of Veterinary Medicine (DVM) Degree
In the United States and Canada, the veterinary medical degree is a doctoral-level, professional program. Admitted students have completed intensive prerequisite undergraduate coursework, usually in the form of a Bachelor of Science degree, and have provided evidence of significant animal-related or veterinary work-study experience. The DVM is a four-year program. At most schools, the first three years are spent in lecture and lab style courses and all students in a given class have the same course schedule. In this portfolio, I will refer to these students as pre-clinical students or underclassmen. The final year is spent gaining hands on experience in the academic hospital and/or through externships at private practice hospitals. I will refer to these students as fourth-year or clinical students. Thus, the general curriculum of most veterinary schools is as follows:

**Year 1:** Basic Biomedical Sciences (anatomy, histology, physiology....)
**Year 2:** Pathobiology (pathology, microbiology, parasitology, virology....)
**Year 3:** Medicine and Surgery Lectures and Lab Courses
**Year 4:** Clinical Rotations

Note that there is some variation among schools. Some programs begin the clinical experience at the beginning or middle of the third year. Additionally, many schools are moving toward a more integrated curriculum where clinical exposure begins even earlier and the divisions between course subjects are blurred into integrated courses. Regardless, once a student reaches clinics, their time is usually divided up into 2-4 week blocks or rotations. During these rotations students work in small groups on the various hospital services (e.g, neurology, cardiology, large animal medicine). Student responsibilities differ among hospital services. However, much of the experience I will discuss in this portfolio involves fourth-year students on the small animal internal medicine rotation. On this rotation, students generally assist in all aspects of clinical cases including: history taking, physical examination, diagnostic testing, treatment, and client communication. Although a fully accredited doctor always has the primary responsibility, it is our goal that the students feel ownership and responsibility of these cases as if they were the attending doctors.

**Post-DVM Training**
After graduation, most veterinarians enter general practice with their chosen species of interest. However, a subset moves on to advanced training. For those interested in clinical work with small animals, the first step is a one-year rotating internship. During the internship the trainees work as full doctors in a hospital alongside veterinary specialists and experience all the services, but with a particular emphasis on emergency medicine, internal medicine, and surgery. If a
trainee would like to become a specialist him or herself, then they enter a residency program in their area of interest. These are usually 2 to 3-year programs in which the resident exclusively studies and practices in that area. Additionally, one-year specialty internships are available for individuals who have completed a rotating internship but were unable to gain entry into a residency program that year. In this portfolio, I use the term “interns and residents” or “house officers” as a general term for all three types of post-doctoral trainees.

A Final Word on Species Terminology
In this portfolio, I will use the phrase “small animals” to refer to dogs and cats, exclusively. This is in contrast to “large animals,” which includes equids (horses) and production animals (cattle, sheep, goats, pigs, camelids, or other species that yield commercial products). Although non-veterinarians often assume “small animal” means animals that are physically small in size, such as rodents, rabbits, and ferrets, these species generally fall under the heading of “exotic/zoo/wildlife” species.

I will also use the phrase “small animal medicine” to refer to the practice of veterinary medicine on dogs and cats. This includes diagnosis and treatment of disease, surgical procedures, and preventative medicine. In contrast, I will use the phrase “small animal internal medicine” to refer to the practice of internal medicine on small animal species. This is a specialty area of veterinary medicine in which practitioners work on cases that are difficult to diagnose or treat, particularly when multiple disease processes are present. I am a small animal internist; so much of this portfolio is written from a specialist’s perspective of veterinary medical education.
As the Veterinarian’s Oath says, practitioners are not only tasked with protecting the health and welfare of our patients, but have larger obligations to society through the promotion of public health and advancement of medical knowledge. Thus, I take my role as a veterinary educator very seriously and consider the quality of training I provide my students a part of my overall contribution to the profession. From my perspective as an internist, clinical reasoning is the foundation of medical practice and a vital component of veterinary education. This skill is independent of body system or even species, so aptitude gained in one course is universally applicable across the field. Therefore, my overarching teaching goal is to facilitate the development of clinical reasoning in students and to provide a variety of opportunities to reinforce and build upon those skills. I seek to achieve this goal through three learner-centered themes: case-based learning, learner self-awareness, and adaptive teaching.

**Case-Based Learning**
While facts can be introduced in lecture-style courses, I believe the key to integrating factual information into higher-level concepts is application and repetition. I have also observed that my students tend to be much more engaged when they feel that they are practicing “real-life” skills. Therefore, I use a case-based approach in much of my teaching. For veterinary students, this means working on simulated or live patient cases. I try to use cases during lecture sessions and often incorporate a short interactive example case at the end. I have also developed several projects based around case simulations including my Delta teaching-as-research project in which I built and evaluated several online cases to supplement the veterinary curriculum. However, my favorite form of case-based learning is interacting with fourth-year students as they rotate through the clinics. It is there that I truly am able to see things “come together” for them and develop a deeper understanding of veterinary practice.

Working through cases not only allows students to practice their clinical skills and reasoning but also broadens their exposure to various kinds of disease. Students can then draw from these experiences at later times in their education and career. Repeated exposure to case scenarios can also improve student self-efficacy (a person’s belief in their ability to succeed), which in turn enhances performance and eases the transition between trainee and practitioner. Because case-based learning is such a powerful tool in veterinary education, I believe it is essential to begin using these practices early and to foster critical thinking skills throughout the curriculum.

Introducing pre-clinical students to clinical scenarios encourages them to think about how they can apply the basic medical knowledge they are studying. Correspondingly, reinforcing physiology and pathophysiology during clinical rotations promotes a deeper understanding of cases and enhances clinical reasoning among students about to graduate.

**Learner Self-Awareness**
As in all fields of study, self-awareness and metacognition (awareness of one’s own thought processes) are important skills for veterinarians, as well as indicators of maturing medical practice. I strongly encourage my students to take time to evaluate their own decision-making processes and clinical reasoning – reflection facilitates the construction of mental models and identification of knowledge gaps. Interactive discussion with teachers and peers can also enhance this kind of deep understanding. Beyond medical knowledge, self-awareness also
improves interpersonal skills. Clarification of personal ethics can have positive effects on interactions with clients and other members of the veterinary team. For example, along with other faculty, I designed a seminar to introduce the concept of implicit bias in teaching to house officers at the vet school. We included both individual activities, to allow participants to reflect on their own feelings about this subject, as well as small and large group discussions to facilitate sharing of these positions. I felt these latter discussions were quite effective because they forced participants to consider how implicit bias impacts their teaching and contrast that to others’ ideas on the subject, which may reinforce an individual’s position or provide an opportunity for them to adjust that position based on new ideas.

Student-Centered Teaching
Like every doctor, every student is different and understands concepts in their own way. I try my best to adapt my teaching style to each individual and maximize their learning experience. This is another reason I enjoy teaching in the hospital setting because the clinics provide a flexible learning environment with many opportunities to teach to the individual. One student may learn best through discussion, where another would learn better through a step-by-step presentation. Other students may gain the most benefit from an assignment that asks them to seek information for themselves through the primary literature. I also use the documents students generate for hospital cases to assess comprehension. I do my best to give formative feedback on discharge instructions, both praising good work and filling in knowledge gaps or misconceptions. This feedback is usually in the form of a discussion, which can present yet another individual learning opportunity.

Another area where I have recently developed my student-centered teaching skills is through mentorship of students in a laboratory setting. Although these are students with different goals and challenges, my approach is similar to that with veterinary students. There are diverse opportunities in the laboratory environment for teaching – guided bench work, poster design and paper writing, lab meetings, journal club, etc. Additionally, I can adjust a lab project to suit the needs of the individual student to maximize their laboratory experience. Adapting my methods to suit individual students provides them with unique learning opportunities and gives them the best chance to learn and maximally benefit from the experience.

By focusing my teaching efforts on clinical reasoning and the decision-making process, I help my students to develop personalized approaches to veterinary medicine. When they graduate, I want my students to practice medicine to the best of their abilities. This is not only because of the personal satisfaction I have in seeing them succeed, but because my students are also my future colleagues. By helping to train high quality veterinarians, I am also helping to forward the profession as a whole and advance the goals laid out in the Veterinarian’s Oath.
From the beginning of their academic training, veterinary students are taught to think of themselves as serious medical professionals. However, few students entering the field comprehend the degree to which veterinary researchers contribute to both animal and human health. A summer or yearlong laboratory experience can be invaluable to a veterinary student. A deeper understanding of translational research will enhance the student’s medical knowledge base. More importantly, the critical thinking skills learned in the laboratory are the same skills that govern clinical decision-making. It is with these goals in mind that I approach mentoring a veterinary student in the lab.

When a student enters the lab, my first objective is to determine what they hope to gain through the research experience. Different veterinary students have different career goals and these goals can change over time. Thus, it is important to maintain an open line of communication between mentor and mentee so that goals and expectations can be adjusted accordingly. For example, I always try to be present the first few times a student uses a new technique – that way we can talk through the procedure the first time and then I am available for questions on subsequent runs and to discuss variations that may occur. I also regularly engage my students in conversation about the project – rather than lecturing to them, I ask them to explain to me what they have learned and then I can fill in the gaps. Such communication helps me to iteratively assess my student’s level of understanding regarding the project. Ensuring comprehension is key to keeping the student engaged in research.

In general, veterinary students tend to be focused on what is clinically applicable – the information and skills they need to be successful in medical practice. Therefore, when working with these students in the lab, it is very important to help them keep the “big picture” in mind. Although attention to detail is very important, it is easy for a novice to get bogged down in the minutia of laboratory technique. For a veterinary medical student, this loss of focus could result in loss of interest in the project or loss of interest in research entirely. By reinforcing the larger structure of the project and the potential future clinical impact of the study, students are more likely to remain engaged and to learn the patience and persistence requisite of any research scientist. I believe this is best achieved by giving students opportunities to interact with other scientists. If their schedule permits, I encourage my students to attend journal clubs and lab meetings. Furthermore, presenting at such events forces students to assess their own comprehension and identify knowledge gaps, which I can then address with them. I would also like my students to have the opportunity to attend conferences and meetings so they can see how their work fits into the larger scientific community.

Another way to keep students engaged and passionate about research is to encourage them to develop a sense of ownership over their own work. Rather than having students work on a few small pieces of other lab members’ projects, I feel it is usually better to give students their own small project that fits into the larger goals of the lab. Veterinary medical students are intelligent and highly motivated, particularly those with a research interest, and should be capable of handling such a responsibility with appropriate guidance. Given enough time, it may also be beneficial to involve a student in experimental design. By contributing to both the design and execution of a study, students will be that much more invested in the project. Additionally,
methodical problem solving is an invaluable skill for all students, but particularly for those entering the medical field as this skill directly translates to diagnostic abilities.

Research training of veterinary students improves critical thinking skills in a way complimentary to their medical education. By tailoring the laboratory experience to the individual, integrating the student’s project into the “big picture” of the field of study, and encouraging students to take ownership of their work, veterinary students can be very successful in a research environment. Such experiences not only enhance skills that are useful to a practicing veterinarian, but also expose the student to veterinary career opportunities that they may not have previously been aware of or considered for themselves.
THEME I
CASE-BASED LEARNING
Artifact 1: “DDX: From Problems to Plan” Student Mini-Workshop

Description:
Between 2011-2014, I undertook advanced training in small animal internal medicine as a resident at Kansas State University. In addition to my clinical duties, I also assisted in the training of fourth-year veterinary students by collaborating with them on cases. In general, my students had good basic medical knowledge, but seemed to struggle to apply that knowledge in a logical manner. For example, when asked to generate a list of possible diagnoses for a patient, they often seemed to pick diseases at random, rather than methodically considering the different possibilities and choosing the best differentials for their patient.

The workshop began with a short lecture on the problems-based approach to diagnosis, which emphasized beginning differential diagnosis using general categories of disease processes and then moving to specific differentials (Figure 1a). We then worked as a group to come up with an approach to different medical problems students might see in clinical cases, again using a general-to-specific approach (Figure 1b). Finally, the workshop concluded with a section on pattern recognition where a set of problems could be used to quickly narrow down the differential list to a specific disease or group of diseases (Figure 1c).

For Each Major Problem, Ask...
- What are the general categories of disease?
- Based on what I already know, can I rule any of these in or out?
- What are specific differentials for my patient for the remaining categories?
- What diagnostics do I need to perform to differentiate these?

Figure 1a – Slide from PowerPoint lecture outlining a general-to-specific thought process for problems-based differential diagnosis.

These kinds of mistakes are part of the normal learning process and can be suitably addressed in one-on-one learning situations. However, I felt that there might be other ways to emphasize a problems-based approach for patient diagnosis that would supplement student case experience. During this time, I developed a one-hour mini-workshop for fourth year students entitled “DDX: From Problems to Plan” that I gave during downtime on the rotation. DDX is shorthand for differential diagnosis, so this workshop was intended to help students develop differential diagnosis lists for their patients in a logical manner.
Reflection:
This was my first attempt helping veterinary students to develop their diagnostic thought processes in a didactic setting. Overall, students seemed to enjoy the activity. They were most engaged during the second and third sections of the workshop, which involved participation. A group setting really was a great way to cover this kind of material. Coming up with differential diagnoses is, at its core, a brainstorming activity; so the lists that the students generated together were larger than one any single student could have generated on their own. Each student had their own set of experiences – previous rotations, working in different veterinary clinics, and what they took away from the pre-clinical coursework. This variety of experience allowed the students to generate richer differential lists. For example, one student may have had a case of heat stroke on emergency, which would be a kind of environmental hyperthermia, and another student might have seen a case of pneumonia causing a fever on the general practice rotation. Together, these students would have a much larger knowledge of differentials for an elevated temperature (Figure 1b) than either would have had on their own.

Looking back, I think I could have done more to make this activity even more interactive. Although students spoke, the discussion was still primarily centered on me, as the instructor. Different students contributed different amounts to the discussion with some of the more vocal students becoming the “spokespeople” for the group. Additionally, because the differential lists were displayed on pre-fabricated PowerPoint slides, there appeared to be “right and wrong answers,” even though that was not my intent. One way to address these issues might be to use a combination of large and small group discussions. This would stimulate more student-to-student communication and give quieter students a less intimidating environment to voice their ideas. Whiteboards or worksheets also might be a more appropriate learning tool in this situation because these are more open and less prescriptive modes of written communication than PowerPoint.

Another area that I would like to address is that, in retrospect, parts of this activity may have been too general for fourth-year students. Many of the concepts in the differential diagnosis lists had already been previously taught. Instructors in the pre-clinical curriculum may have already covered the general and specific diagnoses for problems like anemia or fever. Therefore, the workshop may have appeared to be simply a review to the students rather than a chance to improve critical thinking skills. Additionally, generating a complete differential list is only the first step because the list must then be narrowed based on characteristics of the individual patient. This is why my later attempts have included case examples as well as the underlying framework of problems-based diagnosis.

Figure 1c – Example of a pattern-recognition problem as a part of the third section of the workshop.
Description:
In 2013, I worked with the Feline Club at Kansas State University to develop an interactive laboratory experience for first through third-year veterinary students. In this lab, students were broken into small groups (3-5 student per group) and specifically intermixed so that all classes were represented. This brought different levels of experience to each group. A fourth-year student volunteer, who had completed the small animal internal medicine rotation, led each group. These groups worked through five different case examples of ill cats. Students were given a worksheet with the history and physical exam findings and also a space to work through lists of problems and differential diagnoses (see next page for example worksheet).

Stations were set up throughout the room for students to examine test results for each case including bloodwork (Figure 2a), imaging studies (Figure 2b), and additional diagnostic tests. Interns and residents ran these stations and provided guidance for the student groups. Throughout the lab, “Easter egg questions” scattered. These questions were written for specific class levels (first, second, or third year students) and were based on the material that was taught in each year (Figure 2c). If a group came upon an “Easter egg question” then the members of the appropriate class in the group could answer the question and receive a bonus (candy) for their group. This component was specifically added to encourage younger students to participate and recognize their contributions to the groups.
Case 4 – Muffy – 7yo FS Siamese

**History:** Muffy presents today for a 7 day history of anorexia and progressive lethargy over the past 5 days. She has a history severe upper respiratory infection as a kitten and has chronic intermittent flare ups of rhinitis and sinusitis, presumably due to a chronic feline herpesvirus infection. She is otherwise healthy, indoor only, and up to date on vaccines. Her family recently moved to the area from Chicago.

**Physical Exam:**
- **T** 100.3F  
- **P** 192bpm  
- **R** 16rpm  
- **Wt** 7.9kg  
- **BCS** 5/5  
- **Mentation** QDR

**General Appearance:** Depressed, overweight  
**Ears:** mildly icteric pinnae  
**Eyes:** icteric sclera, bilateral ocular discharge  
**Oral Cavity:** moderate tartar, mildly icteric, tacky gums, CRT ~2s  
**Lymph Nodes:** WNL  
**Muskuloskeletal:** overconditioned  
**Skin:** icteric, prolonged skin tent  
**Pulses:** strong and synchronous  
**Perineum:** WNL  
**Abdominal Palpation:**  
- **Liver/Spleen:** cranial organomegaly  
- **Gastrointestinal:** WNL  
- **Urinary:** normal kidneys, small and soft bladder  
- **Other:** mildly tense on palpation  
**Cardiovascular:** WNL  
**Respiratory:** mild stertor, mild clear nasal discharge  
**Neurologic:** WNL  
**Rectal:** not performed

**Problems List:**

This is an example of a case worksheet for the Feline Drylab. It contains initial information about the case including the history of the case and what would be found upon initial examination. The worksheet then provides space for the student groups to generate problems and differential lists. These lists then lead students to the Diagnostic Plan in which they can request additional diagnostic information from the stations.
**Differential Diagnoses:**

Problem #1: ____________________  Problem #2: ____________________

**Diagnostic Plan:**

**Diagnostic Results:**

**Diagnosis:** ____________________________________________________________

**Treatment Ideas:**
Reflection:
The Feline Dry Lab turned out to be really wonderful and I think everyone involved benefitted from the experience.

When I designed the lab, I was a nervous that integrating the first, second, and third-year students in groups might not work. I was concerned that the third year students, with their greater experience, would dominate and that first and second-year students might feel intimidated. This is why I included the “Easter Eggs” because, although third-year students had taken the classes from which the questions came, the first and second year students would be closer and more familiar with that material. This absolutely paid off – younger students were able to answer their questions and remind the older students about basic science information they had forgotten. In turn, the older students took on a bit more of a mentorship role when it came to more clinical information. These groups are a great example of learning communities – where different people bring together their own knowledge and experiences and are able to teach each other.

These small group-learning communities were infinitely enhanced by their fourth-year group leaders. I had initially intended the fourth-years to act more as guides and bring the participants to the different stations where the interns and residents would do most of the instructing. However, these students took the initiative and led their groups through the entire diagnostic process. I think this was beneficial for the underclassmen to see students just a couple of years ahead of themselves demonstrate such high levels of diagnostic competency. In turn, by teaching others, the fourth-years solidified their knowledge and strengthened their confidence in their own abilities.

In the end, the interns and residents (myself included) felt a little superfluous because the fourth-years essentially ran the show. However, this turned out to be a wonderful thing because we saw our students teaching others, which I believe is the ultimate test of successful teaching. The sense of pride and satisfaction in seeing our students’ accomplishments is unrivaled. This experience emphasized to me how powerful learning communities can be in an appropriate setting. I hope to continue to use and develop these strategies in my future classes.

One aspect that I would like to improve in the future is the way that the initial case history and physical exam information are conveyed to the participants. In many case simulation activities, these pieces are simply written out and read by the students. When, in reality, obtaining a history and physical exam are active processes and important skills to develop. In the future, clinicians or upper classmen could pose as clients and the participants could ask questions to obtain information about the case. Live animals or dummies could be used to practice performing physical exam. Steps such as these would make the dry lab more realistic and expand the skill set of participants.

Another feature that could be added to this activity is an assessment to determine the efficacy of the drylab in improving diagnostic skills in underclassmen. Although this was for a club rather than a class, it would be interesting to design an assessment for a voluntary activity. I believe veterinary students would be amenable to this, with the understanding that the assessment is intended to make further improvements to the drylab; they might also appreciate having feedback on their own performance.
Artifact 3: Delta Internship Project

Use of Virtual Patients with and without Self-Assessment Prompts to Enhance Diagnostic Competency in Fourth-Year Veterinary Students

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ABSTRACT

Background: Virtual patients (VPs) are online case simulations that have been used in both human and veterinary medical curricula to improve student diagnostic competency and confidence. Self-explanation prompts at key steps in the diagnostic process may further enhance these key medical proficiencies.

Objective: The purpose of this study was to assess the effect of VPs with and without self-explanation prompts on diagnostic competence and confidence in veterinary students.

Subjects: 19 fourth-year veterinary students completing the small animal internal medicine rotation at the University of Wisconsin Veterinary Medical Teaching Hospital.

Methods: Students completed three VPs on feline respiratory disease; half used a self-explanation prompt worksheet along with the online module (PROMPT group) and the other half did not (NO PROMPT group). Diagnostic competency was assessed using a pre-/post-test instrument; diagnostic competency gain was defined as: post-test score – pre-test score. Student confidence with respiratory disease diagnosis and treatment was assessed in a post-survey; students were asked to rate their comfort level prior to and after completing the VPs in the same post-test.

Results: There was no significant difference in diagnostic competency gain between groups. However, comfort level increased in all students for both diagnosis and treatment of respiratory disease. Moreover, group PROMPT had a larger increase in comfort level for diagnostic skills.

Conclusions: VPs and self-explanation prompts improve student confidence in case management and are valuable teaching tools for veterinary educators.
INTRODUCTION

Most veterinary curricula in the first three years consist of lecture- and lab-based courses, followed by a final year spent rotating through the various specialty services in the teaching hospital. This clinical year provides students with hands-on experiences and opportunities intended to transform their basic medical knowledge into clinically useful skills and diagnostic competency. However, twelve months is far too short a time to expose students to all the possible disease situations they will encounter upon graduation. In particular, veterinary students at the University of Wisconsin only spend 2-4 weeks on the small animal internal medicine service, yet the diagnostic skills honed on this service are the bread-and-butter of small animal practice. Therefore, additional opportunities for students to augment their diagnostic competency, outside of clinic appointments, would greatly enhance their learning experience.

Online case simulation modules, or virtual patients (VPs), are an effective way to provide additional diagnostic experiences. VPs have been studied extensively in human medical school settings, with overall positive results. These studies have assessed both objective measures of diagnostic competency as well as student affective responses.1-4

Veterinary medical schools are also moving toward similar supplemental web-based teaching modalities.5-9 A variety of VPs have been reported in veterinary curricula with various interfaces and student/instructor responses. Byron et al.10 and Dhein et al.11 both reported high student satisfaction with an online VP platform. The latter study also included individualized instructor responses to students through a virtual learning community. However, instructors felt that the time required to maintain this learning environment was excessive and the program was ultimately discontinued. In an interesting, “inverted” implementation of the VP, Trace et al.12 reported a program in which final-year veterinary students created VPs based on their experiences on clinical rotations. These student-authored cases were later developed into interactive VPs for use in the underclassmen curriculum. Feedback showed that students found designing these cases helpful and that they improved clinical understanding.

Diagnostic competency is commonly assessed in VPs described in the human medical education literature, but this outcome is often lacking in veterinary VP-based studies. In fact, objective measurements of clinical competency are sparsely documented in the general veterinary educational literature.13 One human diagnostic competency model that could easily be applied to veterinary VPs is described by Stark et al.4 This model describes diagnostic competency as a combination of three kinds of knowledge: (1) domain-specific conceptual knowledge, which consists of basic biomedical concepts related to a specific health or disease state; (2) strategic knowledge, which represents the ability to generate differential diagnoses and clinical hypotheses and to describe the next step in the diagnostic process in a clinical scenario; and (3) conditional knowledge, which is the ability to justify clinical decisions based on underlying biomedical processes.
A recent study\textsuperscript{14} used this model to assess the efficacy of self-explanation prompts to improve human medical student performance on worked-example cases, a teaching tool similar to simplified VPs. Self-explanation prompts are short-answer questions presented mid-way through cases. These prompts require students to clearly state their thought processes and provide an opportunity for clinical metacognition. Unfortunately, this study did not show a significant difference in diagnostic competency between student performance with and without self-explanation prompts. However, these prompts could still be useful in a more complex teaching modality such as VPs.

\textit{Teaching-As-Research Questions}

The present study was designed to answer the following Teaching-As-Research questions:

1) Do VPs improve diagnostic competency and confidence in fourth year veterinary students?
2) Do self-explanation prompts further enhance that diagnostic competency?

We hypothesized that veterinary students will have better diagnostic competency after using standardized VPs and that students randomized to be given self-explanation prompts will have greater improvement than those without these prompts.

\textbf{APPROACH}

\textit{Overview}

This study was conducted in two-week blocks (\textbf{Figure 3.1}). Study materials were made available to students through a Desire2Learn course and a Moodle course through Learn@UW. Materials included a VP activity (three feline respiratory case simulations) as well as survey and test assessments bookending this activity. The study was introduced to students on the first Monday of the block and a wrap-up meeting was conducted on the second Thursday. Students were expected to complete the assessments and activities on their own time between these two meetings. These could be completed in a single sitting or broken up into multiple time periods. The assessments and activities were designed to take up no more than 60-90 minutes of the students’ time.

\textbf{Figure 3.1} – Study block timeline.
Study Population
This study included fourth-year veterinary students at the University of Wisconsin School of Veterinary Medicine (UW-SVM) enrolled in the Small Animal Internal Medicine rotation (MED SC-V 678) between 3/7/16 and 5/1/16. This timespan included four 2-week blocks of students. Participation was strongly encouraged but neither participation nor performance affected students’ grades. Because the activities and assessments were included as part of a course, this study was exempt from approval from the University of Wisconsin Institutional Review Board.

Learning Goals
The learning goals for this study are outlined in Table 3.1. These goals are based upon the basic components of diagnostic algorithms taught in veterinary internal medicine: history, physical exam, problem list, disease localization, differential diagnosis list, and diagnostic/treatment plan. These learning goals also include demonstration of critical understanding of the diagnostic process and improved affective response to diagnostic situations.

<table>
<thead>
<tr>
<th>LEARNING GOAL</th>
<th>ASSESSMENT</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEMONSTRATE correct use of a systematic approach to diagnosis of respiratory disease.</td>
<td>Conceptual knowledge: multiple choice questions regarding basic medical knowledge for respiratory disease</td>
<td>Three online VP modules of cats with respiratory signs with and without self-explanation prompts. Students will be guided through the diagnostic process with opportunities to make mistakes. Students will be randomized to receive or not receive self-explanation prompts: - e.g. “Develop a problems list for this patient” - e.g. “Rank order the problems list for this patient” - e.g. “Develop a differential diagnosis list for this patient’s primary problem”</td>
</tr>
<tr>
<td>LOCALIZE disease to the correct part of the respiratory tract based on clinical findings.</td>
<td>Strategic knowledge: vignette style cases followed by short answer questions: - e.g. “list your top three differential diagnoses” - e.g. “what should you do next?”</td>
<td></td>
</tr>
<tr>
<td>CONSTRUCT a directed differential diagnosis based on patient demographics and disease localization.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FORMULATE an appropriate diagnostic plan based on the differential list.</td>
<td>Conditional knowledge: vignette style cases including an action taken by a doctor, followed by short answer questions: - e.g. “why did Dr. X perform a nasal biopsy?”</td>
<td></td>
</tr>
<tr>
<td>DESIGN an initial treatment plan based on a suspected and confirmed clinical diagnosis.</td>
<td>Affective domain: survey assessing students’ comfort and confidence with diagnostic situations.</td>
<td></td>
</tr>
<tr>
<td>JUSTIFY a clinical approach based on underlying biomedical knowledge.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAIN overall confidence in diagnostic abilities</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3.1 – Alignment of learning goals, assessments, and activities.
Assessments
The assessments for this study are designed around the model of diagnostic competency presented above and map to the learning goals as shown in Table 3.1. Four assessments were used: a pre-survey, pre-test, post-test, and post-survey. These surveys and tests book-ended the VP activity (Figure 3.1). All assessments were made online, through a Learn@UW Desire2Learn course.

Surveys – The pre-survey consisted of multiple choice and fill in the blank questions to obtain demographic information (Appendix A). The post-survey included an 8-question likert scale designed to assess student comfort with diagnosing and treating respiratory disease. In order to avoid response shift bias, the post-survey, taken after the VP activity, asked students to rate their comfort level PRIOR to using the VPs and AFTER using the VPs. An open response area was also included for students to provide additional feedback on their experience (Appendix B).

Tests – The pre- and post-tests (Appendix C and D) were designed to assess diagnostic competency as demonstrated in other studies.14 The pre- and post-tests were intended to be isomorphic and each consisted of:

- 10 multiple choice questions (0.5pts each) assessing conceptual knowledge of small animal respiratory disease
- 2 vignette-style short answer questions (3pts each) assessing strategic knowledge (what should you do next?)
- 2 vignette-style short answer questions (3pts each) assessing conditional knowledge (why did Dr. X take this action?)

A rubric was developed on a scale of 0-3 to quantitatively assess each short answer response. The final score for each test was a summation of scores from these three categories. Gain in diagnostic competency for each student was defined as the difference between the post-test and pre-test scores.

Activity – Virtual Patients (VPs)
The main learning modality in this study was the VP Moodle module. This module consists of three simulated cases with similar presentations: young, otherwise healthy cats with respiratory disease. Although the presentations are similar, the disease localizations, final diagnoses, and treatments are very different in each case. The VPs guide students through the diagnostic algorithm and allow them to reach a

Figure 3.2 – Example of a multiple-choice question in a VP consisting of a stem (panel A), distractors with explanatory information (panel B), and correct answer with feedback (panel C).
final diagnosis and therapeutic plan, while highlighting the differences among cases and diseases. Through the VPs, students make both diagnostic and therapeutic choices. The VPs allow for both correct and incorrect answers and feedback is given in both situations (Figure 3.2). Students were encouraged to look at both distractors and correct answers to maximize their learning experience.

**Intervention – Self-Explanation Prompts**
To determine whether self-explanation prompts improve gain in diagnostic competency, the second two rotations of students (4/4/16 – 5/1/16) received a self-explanation prompt worksheet (Appendix E) to be completed alongside the VPs. These worksheets ask students to generate problems lists, rank those problems lists, and create ordered differential lists at key points in the case simulation (Figure 3.3). The hope was that encouraging students to explicitly write out these key steps in the diagnostic process would help improve overall diagnostic competency and foster confidence and metacognition. The students in the first two rotations (3/7/16 – 4/3/16) served as a control group. Due to logistical reasons, group allocation could not be randomized.

**Statistical Analysis**
Continuous data are presented as mean ± standard deviation. All data sets were assessed for normal distribution using the Kolmogorov-Smirnov test. Depending on distribution, unpaired data were compared using a Student’s t-test or Mann-Whitney U test; paired data were compared using a paired t-test or Wilcoxon signed-rank test.

The effect of self-explanation prompts on gain in diagnostic competency was determined by comparing the difference between pre- and post-test scores between the group that received self-explanation prompts (PROMPT) and the group that did not (NO PROMPT). The differences in total scores were compared, as were the differences in individual component scores: conceptual, strategic, and conditional knowledge.
For all students, the change in comfort level was assessed for each skill area for respiratory disease (feline diagnosis, canine diagnosis, feline treatment, canine treatment) by comparing the comfort level prior and after taking the VPs as indicated on the post-survey. To determine whether the self-explanation prompts affected comfort level, the change in comfort level for each area was compared between the PROMPT and NO PROMPT groups. Commercial software (Prism; GraphPad Software, Inc.; LaJolla, CA) was used to perform all statistical analyses. A significance of $p \leq 0.05$ was set for all comparisons.

**RESULTS**

**Study Population**
In total, 19 fourth-year veterinary students participated in this study and completed the pre-survey. The number of students in each rotation was as follows: 5 from 3/7/16 – 3/20/16, 5 from 3/21/16 – 4/3/16, 6 from 4/4/16 – 4/17/16, and 3 from 4/18/16 – 5/1/16. Population demographics are presented in Table 3.2.

**Diagnostic Competency**
17 students completed the VPs as well as the pre- and post-tests. The gain in diagnostic competency for each student is presented in Figure 3.4. There were no significant differences between groups for conceptual knowledge ($p=0.9691$), strategic knowledge ($p=0.1513$), conditional knowledge ($p=0.1064$), or total score ($p=0.0772$).

**Student Comfort Level**
15 students completed the post-survey. The mean comfort level scores for all students are presented in Figure 3.5A. There was a statistically significant increase in student comfort level after completing the VPs in all four skill areas of respiratory disease: feline diagnosis ($p=0.0352$), canine diagnosis ($p=0.0081$), feline treatment ($p=0.0010$), and

### Table 3.2 – Demographic information for study population

<table>
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<th></th>
<th>NO PROMPT (n=10)</th>
<th>PROMPT (n=9)</th>
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<tr>
<td>Age (yrs)</td>
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</tr>
<tr>
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</table>

**Figure 3.4** – Black dots represent gain in diagnostic competency for individual students; black lines represent group means. There was no significant difference in gain of diagnostic competency or its components between the PROMPT (n=8) and NO PROMPT (n=9) groups.
canine treatment (p=0.0057). However, there was a larger increase in comfort level for both feline (p=0.0275) and canine (p=0.0406) diagnosis for students in the PROMPT group vs. the NO PROMPT group (Figure 3.5B). In contrast, there was no significant difference in change in comfort level between groups for feline (p=0.6915) and canine (p=0.1058) treatment.

![Figure 3.5 – Panel A. Comfort levels with clinical skills for respiratory disease for all students who completed the post-survey (n=15). Data are presented as mean and standard deviation; * indicates a significant difference between student comfort level prior to and after completing the VPs. Panel B. Black dots represent gain in comfort level for students in the PROMPT (n=8) and NO PROMPT (n=9) groups; black lines represent group means; * indicates a significant difference between groups.](image)

**DISCUSSION**

The results of this study indicate that VPs with self-explanation prompts do not significantly improve diagnostic competency in fourth-year veterinary students over VPs alone. However, comfort level for respiratory clinical skills did increase with use of the VPs. Moreover, students who used the self-explanation prompts had a larger increase in comfort level for diagnostic skills than those who did not use the prompts. Therefore, VPs and self-explanation prompts appear to be valuable potential tools for veterinary educators.

The lack of a significant difference in diagnostic competency gain between groups in the present study mirrors results seen in medical students. In that study, self-explanation prompts did not improve diagnostic competency, but a similar tool, adaptable feedback, did. Adaptable feedback allows students to select the depth of feedback information given in response to a diagnostic choice made. If a student feels uncomfortable with the material, basic biomedical information is provided. If a student is more confident in their
choice, then higher-level, integrative information is given. Such a tool may also be beneficial for veterinary students.

These negative findings regarding self-explanation prompts highlight several important points about education studies using a pre- and post-test design. First, if the effect of a learning modality on a skill is to be detected, then it is important that the assessments be isomorphic. Isomorphic assessments evaluate the same material at the same difficulty level while using different questions. Thus, if the pre- and post-tests used in this study were not isomorphic, then the lack of a difference between groups could be because gain in diagnostic competency was not accurately quantified by the tests. Unfortunately, it can be very difficult to prove that assessments are isomorphic. Ideally, the pre- and post-tests would have been validated in a separate group of fourth-year students prior to use with the VPs. However, this was not possible due to time constraints.

Interestingly, there was a trend towards significance for the difference in total diagnostic competency score ($p=0.0772$), with more gain occurring in the PROMPT group (Figure 3.4). This trend is also present, though less pronounced, for the strategic and conditional scores, which are the higher-level knowledge areas that contribute to diagnostic competency. Therefore, it is possible that there is a significant difference between groups, but this study was not powered to detect such a difference. A post hoc sample size calculation (powerandsamplesize.com) demonstrated that 20 students in each group would be needed to detect a significant difference with 80% power.

The most important finding in this study is that VPs improved student comfort level with diagnosing and treating respiratory disease. This fulfills one of the study’s primary objectives – to improve student confidence in their diagnostic abilities. Confidence is very important for young doctors because one needs to feel that they can rely upon a diagnosis in order to make treatment and management decisions for a patient. Confidence comes largely from experience and repetition. The main purpose of the VPs was to provide more opportunities to practice diagnostic algorithms and exposure to difference case situations. Therefore, it makes sense that the VPs would improve student comfort level.

Another important finding is that students who used the self-explanation prompts during their VP experience had a larger gain in comfort level than those that used the VPs alone. This suggests that, although self-explanation prompts did not improve objective measures of diagnostic competency, they are a valuable addition to VPs because they further augment student confidence. Interestingly, the difference between the PROMPT and NO PROMPT groups was only significant for diagnostic skills, not treatment. The self-explanation prompts focused exclusively on diagnostic skills (problems and differential lists), which likely accounts for this result. Comfort level gain was higher for both feline and canine diagnosis, suggesting that diagnostic skills practiced in one species improves student confidence for disease in related species.
There are several limitations to this study. As discussed above, the sample size may not have been large enough to detect a significant difference in diagnostic competence gain between groups. Also, group allocation was not randomized – ideally, group assignment would have been stratified by rotation block to account for differences in cases seen on clinics and instructors leading the rotation. Similarly, the timeframe in which students completed the VPs and assessments was not standardized. This was a purposeful decision intended to maximize participation by allowing students to fit these activities into their busy schedules. However, this introduced additional, uncontrolled variability. For example, a student who completed the module toward the end of the rotation would be expected to perform better than had he or she completed it at the beginning because of the extra case experience gained while on clinics.

Overall, the VPs proved to be a positive and beneficial experience for the students. It is our hope to expand these modules to include other types of cases including hematologic, gastrointestinal, and endocrine disease in both cats and dogs. The ultimate goal is to include these cases as a routine part of the internal medicine rotation. The VPs may also be useful in other fourth-year rotations (e.g. surgery, ophthalmology, large animal medicine) or could be adapted for use with students earlier in the veterinary curriculum. Future modifications, such as addition of adaptable feedback or increased case complexity, could further improve the utility of this valuable teaching modality.

ACKNOWLEDGEMENTS

The authors would like to thank Tyler Gregory for technical implementation of the virtual patient modules and online course development. The authors would also like to thank Devin Wixon and the UW Delta Program in Research, Teaching, and Learning for assistance with study development as well as the internal medicine faculty, residents, interns, and technicians who supported this project. Finally, the authors thank the fourth year veterinary students who graciously participated in this study and gave valuable feedback. Dr. Reinhart is supported by grant T32 OD010423 from the National Institutes of Health.

REFERENCES


Reflection:
As a part of the Delta internship, I wrote the following reflection on how my project used and was influenced by the three Delta Pillars:

Teaching As Research
As someone with a background in clinical trials, performing education-based research was a very interesting experience. There are many similarities between clinical and education studies. First, the experimental unit in both study types is a whole individual (patient vs. student); individuals are complex entities, which means that there are a multitude of variables, many of which cannot be controlled or even appropriately stratified. Both study designs stress the concept of an intervention that differentiates study groups. This necessitates a control group for which there can be ethical considerations. In clinical trials, the control must be an active control, meaning that they must receive the current standard of care. Similarly, in education trials, it is unethical to deprive the control group of standard teaching methods to demonstrate the intervention has efficacy.

One study feature, which differs between clinical and education-based studies, I struggled with during this project is assessment. Education assessments are analogous to outcome variables in clinical trials. However, instruments in education research are inherently more subjective and thus not as well standardized as in clinical research. In my project, I was not able to show a significant difference in diagnostic competency gain between the intervention and control groups. One possible reason for this is that the pre- and post-tests did not adequately assess diagnostic competency. Unfortunately, there is no established gold standard for this skill in veterinary medicine – largely because diagnostic competency is difficult define and even harder to assess. This problem highlights the need for better assessments for clinical skills in veterinary students. Ideally, these assessments would map to clinical performance after graduation. This is an area of education research I am interested in pursuing further.

Learning Community
Unfortunately, my TAR project did not include a large learning community aspect because both the assessments and activities were performed through online modules on students’ own time. However, I greatly enjoyed meeting with the students at the end of each rotation to discuss their experiences with the project – the feedback given there was much more substantial that that I received from the online post-survey. Students would “piggy-back” on each other’s ideas for modifying the modules and seemed genuinely invested in improving this teaching tool for future students.

My major exposure to learning communities during the internship was in our weekly seminar. This was a very valuable experience because of the diversity of projects and specialty areas represented among my peers. There are so many teaching and assessment tools available for STEM teaching that it would be impossible to use them all in a single project. By working as a cohort, we were all exposed to more methods than had we used individually. It was also very interesting to see the same method, such as pre-/post-testing, implemented in a variety of contexts. Finally, receiving and giving peer feedback were invaluable to my project and my growth as an educator.
Learning-through-Diversity
For me, learning through diversity is the most difficult of the three Delta core ideas to incorporate into my teaching. The veterinary student population is, on its surface, fairly homogenous – predominantly young, white women. However, subtler sources of diversity such as cultural background, income level, and rural vs. urban upbringing can still significantly affect the way a student’s learns. Proficiencies in veterinary medicine are gained largely through experience. Thus, creating environments that promote openness and allow students to share their diverse experiences should enhance student learning. Small group study is an ideal way to create such an environment. The case-based learning I used in my TAR project is easily adaptable to small group work. This is an area on which I hope to expand through my future teaching commitments.
THEME II
LEARNER SELF-AWARENESS
Artifact 4:
Microteaching Experience – “Virtual Dissection” for a Veterinary Ethics Course

Description:
As a part of the Delta course EPD 654: The College Classroom, I created a 20-minute, microteaching lesson. This lesson was given twice, a few weeks apart, so I could incorporate feedback from the instructor as well as my fellow students in the class. I chose to do my microteaching lesson on the topic of virtual vs. cadaver-based dissection for learning veterinary anatomy. This kind of lesson might be taught in a veterinary or medical ethics course, so I felt it was an appropriate topic for my field. The goals of the lesson were:

- Students should be able to formulate and express a position on the topic of “virtual vs. real dissection in the medical professions”
- This position should be based on critical review of the evidence supporting both virtual and real dissection

In the first microteaching session, I used the first 10 minutes to give a short lecture reviewing the definitions of virtual and cadaver dissection, as well as the ethical literature surrounding the subject (Figure 4a). In the second 10 minutes, we did a values clarification exercise. I placed signs along one wall of the room in a spectrum ranging from “Cadaver dissection only” to “Virtual dissection only” (Figure 4b). Students were asked to place themselves along the spectrum based on different questions such as “what kind of dissection should be used in vet school?” and “what kind of dissection provides the best anatomy education for vet students?” Once students had placed themselves, I led a large group discussion asking students from different parts of the spectrum to share their position.

![Figure 4a](image1.png) - A slide from the short lecture demonstrating an example of a digital virtual dissection model.

![Figure 4b](image2.png) - Layout of spectrum for values clarification exercise.
**Reflection:**
As a part of the course, I also wrote a reflection on the experience.

The most helpful aspect of the microteaching experience is that we had two opportunities to practice teaching. In the first microteaching, I was way over-planned. I had separated my lesson into two sections – the lecture and the discussion. I thought that I would convey the information first, and then give the students the opportunity to use the knowledge they had just learned and synthesize their own opinions about the topic (virtual vs. cadaver-based dissection).

Of course, I talked too much during the lecture section and didn’t have enough time for the activity and discussion. So the next time, I focused almost completely on the student activity and found that a lot of the important points I would have made in the lecture came out naturally during the discussion. Those points that students didn’t come up with on their own, I was able to feed into the conversation (I had made a list ahead of time of things I wanted to talk about).

For me, the most important lesson of this experience is that you can make a class “student-centered” without sacrificing the amount or quality of basic material. Although I’d heard that many times before, I’ve always been a little reticent about switching from a traditional lecture-based style because “there’s just too much material,” particularly in the veterinary curriculum. Now, having gone through the process of reorganizing a lesson, I’m eager to see how I can apply these techniques to internal medicine topics.
Artifact 5: Implicit Bias In Clinical Teaching Seminar

Description:
As a culmination activity for the Delta internship, we are asked to give a presentation or seminar about an aspect of teaching to a group outside of the Delta program. I chose to design a seminar for the house officers (interns and residents) at the School of Veterinary Medicine (SVM). For this, I partnered with two other veterinarians at SVM with an interest in education, Drs. Jessica Pritchard and Karen Young, as well as Dr. Simon Lygo-Baker, an education specialist with a partial appointment at SVM. Below is the instructional plan for the seminar as well as examples of teaching tools used in the seminar.

Implicit Bias in Clinical Teaching
UW-SVM House Officer Seminar
Tuesday, September 13th, 2016, 8-9am

Facilitators: Jennifer Reinhart, Jessica Pritchard
Co-facilitators: Karen Young, Simon Lygo-Baker

Learning Goals:
1) House officers will be able to define the term “implicit bias”.
2) House officers will be able to explain how implicit bias affects student learning.
3) House officers will understand that the first, most important step in countering implicit biases in teaching is to be aware of them.
4) House officers will begin to identify some of their own implicit biases, without self-judgment.

Time Table (minutes):
00-05 Settle in
05-10 Introduction to “Top Five Trusted People” Exercise
10-15 Introductory Presentation
15-20 Finish “Top Five” Worksheets
20-30 Student-Case Matching Activity
30-50 Group Discussion
50-55 Group Share
55-60 Wrap-up
**Materials:**
- “Top Five Trusted People” Worksheets
- Student CVs
- Extra Pens
- Power Points: Intro, ER Board for Student-Case Activity, Wrap-up

**Methodology:**

00-05  
**Settle in**

05-10  
**Introduction to “Top Five Trusted People” Exercise (JP)**
Will ask participants to fill out the first column of the worksheet with the names of five people they trust (ideally not family members).
Participants should not yet open the folded part of the worksheet.

10-15  
**Introductory Presentation (JR)**
Power-point mini-lecture defining implicit bias. Use example of optical illusions – that what we see and what we perceive are different because of automatic processes within our brain. Introduce the possible negative, but unintentional consequences of implicit bias in teaching.

15-20  
**Finish “Top Five” Worksheet (JP)**
Participants will open the fold and complete the other columns in the worksheet about their trusted people – age, race, gender, gender identification, sexual orientation, income/professional status.
Emphasis – we are most likely to trust people who are like us.

20-30  
**Student-Case Matching Activity (JR)**
Participants will pair up. Each pair will be given a set of four 4th year CVs. These are the four students on the ER rotation. The Emergency Board will be up on the screen with five cases coming into the service in the next few hours. Participants will be asked to assign students to cases.
Emphasis – bias affects the way we judge a person’s capabilities

30-50  
**Group Discussions (JR, JS, KMY, SLB)**
Participants will form four small groups with one facilitator assigned to each group. For the first half, participants will discuss their choices for student-case matching:
1. What factors from the CVs affected the way you assigned cases?
2. What underlying assumptions about the students do think is present based on these factors (e.g., intelligence, work ethic, level of interest, experience, physical abilities)?
3. Do these assumptions represent implicit bias? Is it ethical to base case assignments on these assumptions?
4. How can we prevent implicit biases from influencing the way we divide work among students? The way we teach/interact with students?

For the second half of the discussion, participants will share (if comfortable) what they learned about themselves through the “Top Five” Worksheet. Key discussion questions:

1. What do you see as some of your own implicit biases?
2. Where do you think these biases came from?
3. How might these biases affect your interactions with students?
4. What can you do to avoid acting on these biases in the future?

50-55

**Group Sharing (JS)**
Will ask each small group to share a discussion point (either about the Student-Case activity or the “Top Five” Activity) with the larger group.

55-60

**Wrap-up (JR)**
Everyone has implicit bias – but that doesn't make us bad people. Introduce the IAT (will email link after seminar) and share my results. The important thing is to accept that we have these biases so we can work on avoiding actions based on those biases.
At the end of the seminar, participants were asked to take an online survey. Approximately 30 people participated in the seminar, but only 4 of them took the survey. However, based on these results, they felt that the seminar, overall, improved their understanding of implicit bias.
RESUMÉ

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Hometown Address;  
1205 Winnebago Dr, Oshkosh, WI 54716

4th Year Clinical Track: Production Animal

Professional Goals: Dairy practice, reproductive special interest

Education:

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Previous Experience:

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<tr>
<td>2007-2010</td>
<td>Veterinarian’s Assistant</td>
<td>Dairy Doctors Vet</td>
</tr>
<tr>
<td></td>
<td>Service</td>
<td>Mt. Pleasant, WI</td>
</tr>
<tr>
<td>2008-2010</td>
<td>Cashier</td>
<td>Target</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Oshkosh, WI</td>
</tr>
</tbody>
</table>

Veterinary Student Activities:

Veterinary Scholars Program, Fricke Lab, Dairy Science, Summer 2013
Student American Veterinary Medical Association (SAVMA), UW Chapter, Member 2012-current
Reflection:
Following the seminar and after receiving feedback from participants and my fellow facilitators, I wrote the following reflection:

This month, I facilitated a workshop on implicit bias for the interns and residents at the vet school hospital. This was a topic with which initially I was not initially very comfortable. However, the program evolved in a very iterative way and I was very pleased with the final product.

Implicit bias is a delicate subject to teach and discuss. Some people cannot immediately distinguish it from prejudice and so may feel attacked or react defensively when confronted with the possibility that they may have such biases. Other people may latch onto the idea that implicit bias is automatic and engrained, allowing them to avoid responsibility for their biases or consequent actions. Going into the workshop, I was very concerned about finding the right balance between these two reactions. I have not had a lot of experience discussing diversity and its implications in a formal setting. Previous Delta courses were helpful (topics in “The College Classroom” and the research mentorship learning community), but I wish I had more formal exposure. I supplemented my lack of experience by using online teaching resources and books; however, the most helpful resource was the group of people who assisted with the design and implementation of the program.

Knowing a small workshop on teaching was a requirement for the Delta internship, I reached out to Dr. Jessica Pritchard, who recently completed the COAT program at NC State – it seemed like a good opportunity to work with someone with similar training and share our interest in STEM teaching. From there, we involved Drs. Young and Lygo-Baker as veterinary educators and clinical education experts, who were then able to recommend other experts throughout campus. Each person with whom I worked brought a different point of view. Sometimes, I find too many perspectives to be overwhelming, but, because I was such a novice in this area, I tried to keep myself open to all ideas and allowed the program to change as new concepts or activities were suggested.

Overall, I feel the workshop was a success. The major goal was to simply make our interns and residents more aware of the idea of implicit bias. Hopefully, this will lead to better self-awareness and more conscientious behavior during clinical instruction. During the program, we provided multiple opportunities for participants to recognize and understand bias in their own lives. For example, in the first activity, the “Top Five Trusted People,” participants listed out demographic information (e.g., gender, race, profession) about people they trust and then were asked to compare those characteristics to themselves. The purpose was to show, in a non-judgmental way, that we are more likely to trust people like ourselves than people who are different as a basis for understanding implicit bias. Participants really seemed to respond to this activity.

One way the program could be enhanced is by improving the examples used. I found it very difficult to come up with realistic examples of implicit bias in a clinical teaching setting that were non-obvious. Specific situations are an important way people learn and can practice using newly acquired knowledge and skills. However, it is important that participants find examples applicable to their own lives or the impact of the exercise is lessened. This is a part of the workshop I hope to refine if I have another opportunity to facilitate this program.
This workshop on implicit bias challenged participants to identify and deal with implicit bias in their teaching. Designing the workshop challenged me as well – I learned that you don’t have to be an expert in a subject to teach effectively, but you do have to be willing to find the resources that you need and be open to making changes as new ideas come along.
THEME III
STUDENT-CENTERED TEACHING
Artifact 6: Laboratory Mentorship

Description:
As a PhD student, I have mentored two students in the lab:

Giselle
When she came to our lab, Giselle was a senior high school student participant in the Pre-college Enrichment Opportunity Program for Learning Excellence (PEOPLE) at the University of Wisconsin-Madison (Figure 6a). PEOPLE is a pre-college pipeline for middle and high school students from underrepresented minorities. These students are invited to spend their summers on campus and participate in various scholarly programs. In their senior year, PEOPLE participants spend half their time in an immersive internship experience. Giselle’s interest is in animal sciences and she hopes to work with zoo animals and wildlife in her future career. Therefore, Giselle chose to do her internship at the veterinary school in the lab of Lauren Trepanier, my PhD advisor.

Amelia
When Amelia joined our lab, she was a sophomore at the University of Wisconsin in the genetics department (Figure 6b). I mentored her in a program through Bio 152, the Honors Introductory Biology course. The course required students to complete a short laboratory project, write a paper, and design a poster that would be presented at a final poster session. After graduation, Amelia hopes to go to vet school and she has a strong interest in genetics. Therefore, our lab was a perfect fit!
Reflection:
Both Giselle and Amelia worked on a project that assessed the genotype frequencies in healthy dogs for a single nucleotide polymorphism in the cytochrome \( b_5 \) reductase gene that has been associated with sulfonamide allergy. However, each student was at a different stage in their education and had a different level of understanding of the material, so I knew that I had to adapt the project to make it appropriate for each of them. Furthermore, Amelia was fairly extroverted and confident, whereas Giselle was more introverted and initially uncomfortable in the lab, so I had to adapt the way I interacted to suit the individual.

Whenever I have a student start in the lab, I feel it is important to establish goals that can frame the experience for the student and provide structure. This provides a more satisfying experience for the student because it enhances the sense of accomplishment. The primary purpose of the PEOPLE internship is to expose students to scientific research and the impact it has, but I also wanted Giselle to really understand the work she was doing. The concepts of PCR and sequencing had come up in her high school biology classes, but Giselle had never actually performed the techniques herself. Therefore, I framed her summer experience to be more about learning and understanding the techniques rather than on the output of her work and generation of data. I found some excellent online, interactive resources (http://learn.genetics.utah.edu) to help Giselle understand the basic concepts of cell and molecular biology and how those translate into how PCR and Sanger sequencing actually work. These tools were particularly useful because Giselle preferred to work on her own and then check in with me periodically. The web tools allowed her to explore concepts, which we would then discuss later and I could explain parts that didn’t make sense.

In the lab, Giselle also preferred to work in a more self-directed way. She seemed to feel a bit nervous if I was hovering too close. So, after observing her do a technique a couple of times, I would give her some space to work, but be sure I was close by so she could come get me if she needed help. Although, our focus was not on the generation of data, Giselle did quite a bit of work in those six weeks and was able to significantly contribute to our study. I believe that she was able to be so productive because we created an environment where she could flourish. Because Giselle had an interest in animal and science, I also supplemented her work in the lab with trips downstairs to the veterinary hospital. These trips broke up the time in the lab and gave Giselle an opportunity to explore other ways science can be applied.

Having taken college biology, Amelia already had some experience with the techniques used in her project. For her, the hands-on work in the lab was more about reinforcing and perfecting what she already knew. That gave us room to focus more on the larger concepts of the project and how her project fit into the overall goals of the lab. Additionally, the Bio 152 honors program requires both a scientific paper and poster, which provided opportunities for us to discuss scientific method, science writing, data analysis, and presentation. The requirements for this program also provided an ideal structure in which Amelia could feel some ownership over a discrete portion of the project, which I feel is important in research mentorship.

Amelia is a very self-motivated individual, so we developed a relationship where she would go to the literature and gather information and then bring it back so we could discuss how to arrange and present the information. I remember a particular day when Amelia suggested the correct statistical test to use for her analysis. It demonstrated to me that she really did understand the format of her data and what information we were trying to glean from the data.
set. I think it was a very satisfying moment for both of us. Amelia went on to write a great paper and make a wonderful poster (Figure 6b). We were so pleased with her contributions that she will be a co-author on the manuscript in which her data are used and she has stayed on in the lab this semester for additional research credit.
## CIRTL Learning Outcomes Matrix

### Associate Level

<table>
<thead>
<tr>
<th>Teaching-as-Research Associates can do the following:</th>
<th>How this outcome was met:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe how to access the literature and existing knowledge about teaching and learning issues, in a discipline or more broadly.</td>
<td>Initially exposed to education literature in the College Classroom course and researched the pre-existing literature for my Internship project.</td>
</tr>
<tr>
<td>Define and recognize the value of the Teaching-as-Research process, and how it can be used for ongoing enhancement of learning.</td>
<td>Again, these concepts were introduced in the College Classroom course and expanded upon during my Internship experience.</td>
</tr>
<tr>
<td>Describe a “full-inquiry” cycle.</td>
<td>Achieved during the Internship seminar.</td>
</tr>
<tr>
<td>Describe how the integration of Evidence-Based Teaching, Learning Communities and Learning-through-Diversity within Teaching-as-Research can be integrated to implement and advance effective teaching practices for diverse learners.</td>
<td>This is discussed in the reflection for my Internship project (Artifact 3).</td>
</tr>
</tbody>
</table>

### Evidence-Based Teaching

<table>
<thead>
<tr>
<th>How this outcome was met:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe and recognize the value of realistic well-defined, achievable, measurable and student-centered learning goals.</td>
</tr>
<tr>
<td>Describe several known high-impact, evidence-based effective instructional practices and materials and recognize their alignment with particular types of learning goals.</td>
</tr>
<tr>
<td>Describe several assessment techniques and recognize their alignment with particular types of learning goals.</td>
</tr>
</tbody>
</table>
### Learning Communities

**Associates can do the following:**

<table>
<thead>
<tr>
<th><strong>How this outcome was met:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe and recognize the value of learning communities, and how they impact student learning.</td>
</tr>
<tr>
<td>Describe several techniques for creating a LC within a learning environment, including strategies that promote positive interdependence between learners so as to accomplish learning goals.</td>
</tr>
<tr>
<td>Describe several techniques and issues of establishing LCs comprising a diverse group of learners.</td>
</tr>
<tr>
<td>Recognize the value of and participate in local professionally focused learning communities associated with teaching and learning.</td>
</tr>
</tbody>
</table>

### Learning through Diversity

**Associates can do the following:**

<table>
<thead>
<tr>
<th><strong>How this outcome was met:</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe the scope of diversity in learning environments, of both students and instructor. Including but not limited to backgrounds, race, gender, ability, socioeconomic status, ethnicity, gender preference, and cognitive skills.</td>
</tr>
<tr>
<td>Describe the impact of diversity on student learning, in particular how diversity can enhance learning, and how inequities can negatively impact learning if not addressed.</td>
</tr>
<tr>
<td>Describe how an instructor’s beliefs and biases can influence student learning.</td>
</tr>
<tr>
<td>Describe and recognize the value of drawing on diversity in the development of teaching plans (including content, teaching practices and assessments) to foster learning.</td>
</tr>
<tr>
<td>Describe several learning-through-diversity (LtD) techniques and strategies.</td>
</tr>
</tbody>
</table>
## Practitioner Level

### Teaching -As-Research

<table>
<thead>
<tr>
<th>Practitioners can do the following:</th>
<th>How this outcome was met in the Delta Certificate:</th>
</tr>
</thead>
</table>
| Develop and execute a Teaching-as-Research plan for a limited teaching and learning project  
  • Find and critically consider the literature and existing knowledge associated with the teaching and learning project  
  • Create realistic well-defined, achievable, measurable and student-centered learning goals for the teaching and learning project.  
  • Find or develop assessment (measurement) tool(s) that are aligned with the learning goals of the teaching and learning project.  
  • Develop a teaching plan (a hypothesis) to accomplish learning goals.  
  • Implement the teaching plan and collect some data regarding achievement of learning goals.  
  • Analyze the data and draw evidence-based conclusions about the impact on student learning.  
  • Complete a full-inquiry cycle for the teaching and learning project by using findings to suggest improvements to the above actions. | All of these outcomes were met through the development, execution, and reporting of my Delta Internship project (Artifact 3). |
| **Show the integration of Evidence-Based Teaching, Learning Communities and Learning-through-Diversity to accomplish learning goals.** | This integration is demonstrated in the reflection for my Internship project (Artifact 3). |

### Evidence -Based Teaching

<table>
<thead>
<tr>
<th>Practitioners can do the following:</th>
<th>How this outcome was met in the Delta Certificate:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access the literature and existing knowledge to develop a deeper understanding of existing evidence-based knowledge concerning high-impact, evidence-based teaching practices.</td>
<td>I performed a deep literature search in preparation for my Internship project so I could use the best practices in both study design and development of the learning tools and assessments (Artifact 3).</td>
</tr>
<tr>
<td><strong>Integrate one or more evidence-based teaching strategies into a teaching plan so as to accomplish learning goals.</strong></td>
<td>Implementation of virtual patients and selfExplanation prompts for students in my Internship project to achieve the learning goals laid out therein.</td>
</tr>
<tr>
<td><strong>Implement one or more evidence-based teaching strategies for students in a learning experience.</strong></td>
<td>Implementation of virtual patients and selfExplanation prompts for students in my Internship project to create a positive learning experience for participants.</td>
</tr>
</tbody>
</table>
**Practitioner Level continued**

<table>
<thead>
<tr>
<th>Learning Communities</th>
<th>How this outcome was met in the Delta Certificate:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practitioners can do the following:</strong></td>
<td><strong>Access the literature and existing knowledge to develop a deeper understanding of the knowledge concerning LCs and their impact on student learning.</strong></td>
</tr>
<tr>
<td></td>
<td>This was accomplished through my research in preparation for the &quot;Implicit Bias in Clinical Teaching&quot; seminar (Artifact 5).</td>
</tr>
<tr>
<td></td>
<td><strong>Integrate one or more LC strategies into a teaching plan so as to accomplish learning goals and learning-through-diversity.</strong></td>
</tr>
<tr>
<td></td>
<td>Demonstrated this outcome through the development of class-level integrated groups in the “Feline Dry Lab” (Artifact 2).</td>
</tr>
<tr>
<td></td>
<td><strong>Implement one or more LC strategies for students in a learning experience.</strong></td>
</tr>
<tr>
<td></td>
<td>Demonstrated this outcome through the development of class-level integrated groups in the “Feline Dry Lab” (Artifact 2).</td>
</tr>
<tr>
<td></td>
<td><strong>Contribute to local professionally-focused learning communities associated with teaching and learning.</strong></td>
</tr>
<tr>
<td></td>
<td>I presented my Delta Internship project at the All-Network CIRTL meeting on 2-16-17 and I presented my final project for Effective Teaching with Technology for the UW DoIT Active Teaching Lab on 4-3-17.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Learning through Diversity</th>
<th>How this outcome was met in the Delta Certificate:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Practitioners can do the following:</strong></td>
<td><strong>Access the literature and existing knowledge to develop a deeper understanding of diversity and its impact on accomplishing learning goals.</strong></td>
</tr>
<tr>
<td></td>
<td>This was accomplished through my research in preparation for the &quot;Implicit Bias in Clinical Teaching&quot; seminar (Artifact 5).</td>
</tr>
<tr>
<td></td>
<td><strong>Examine and describe own beliefs and biases, including how they may influence their students' learning.</strong></td>
</tr>
<tr>
<td></td>
<td>This can be demonstrated throughout the reflections in this portfolio. Additionally, I participated in a book club on &quot;Blindspot: The Hidden Biases of Good People&quot; through my graduate program in Fall 2016. This was one of the inspirations for the “Implicit Bias in Clinical Teaching” seminar (Artifact 5).</td>
</tr>
<tr>
<td></td>
<td><strong>Determine the diverse backgrounds among a group of students, and consider the opportunities and challenges of the findings on each student's learning.</strong></td>
</tr>
<tr>
<td></td>
<td>Demonstrated this outcome through the development of class-level integrated groups in the “Feline Dry Lab” (Artifact 2).</td>
</tr>
<tr>
<td></td>
<td><strong>Create a teaching plan that incorporates content and teaching practices responsive to the students' backgrounds.</strong></td>
</tr>
<tr>
<td></td>
<td>This was accomplished through my research mentorship (Artifact 6), in which I adapted a similar project to two different students with different backgrounds and content knowledge.</td>
</tr>
<tr>
<td></td>
<td><strong>Integrate one or more LtD techniques and strategies in a teaching plan so as to use students' diversity to enhance the learning of all.</strong></td>
</tr>
<tr>
<td></td>
<td>The organization of a book club for my graduate program in Spring 2017 of the book “The Immortal Life of Henrietta Lacks” which explores racial and ethical elements of biological research. This book club had alternating leaders so, not only did the discussion promote learning through each other’s viewpoints, but so did the leadership of each session.</td>
</tr>
<tr>
<td></td>
<td><strong>Implement one or more LtD strategies in a teaching experience.</strong></td>
</tr>
<tr>
<td></td>
<td>The organization of a book club for my graduate program in Spring 2017 of the book “The Immortal Life of Henrietta Lacks” which explores racial and ethical elements of biological research. This book club had alternating leaders so, not only did the discussion promote learning through each other’s viewpoints, but so did the leadership of each session.</td>
</tr>
</tbody>
</table>
Appendix A: Pre-Survey

Survey used to collect demographic data about the student participants in my TAR project (Artifact 3).

Age ______

Gender ______

Species of Interest (select all that apply)
  • Small Animal
  • Equine
  • Food/Production Animal
  • Mixed
  • Exotics/Zoo/Aquatics
  • Laboratory

Post-Graduation Plans (select all that apply)
  • Primary Care Practice
  • Internship/Residency
  • Industry/Government
  • Additional degree
Appendix B: Post-Survey

Survey given after completion of the virtual patient modules in my TAR project (Artifact 3). Survey asks students to rate comfort level with various clinical skills before and after using the virtual patients.

All questions will be presented with options 1-5:
1 – very uncomfortable
2 – moderately uncomfortable
3 – neither comfortable nor uncomfortable
4 – moderately comfortable
5 – very comfortable

Questions:

1) PRIOR to working through the online case modules, how comfortable were you DIAGNOSING respiratory disease in CATS?

2) PRIOR to working through the online case modules, how comfortable were you DIAGNOSING respiratory disease in DOGS?

3) PRIOR to working through the online case modules, how comfortable were you TREATING respiratory disease in CATS?

4) PRIOR to working through the online case modules, how comfortable were you TREATING respiratory disease in DOGS?

5) Now, AFTER the online case modules, how comfortable are you DIAGNOSING respiratory disease in CATS?

6) Now, AFTER the online case modules, how comfortable are you DIAGNOSING respiratory disease in DOGS?

7) Now, AFTER the online case modules, how comfortable are you TREATING respiratory disease in CATS?

8) Now, AFTER the online case modules, how comfortable are you TREATING respiratory disease in DOGS?

9) Please provide any comments or suggestions you have for the improvement of these modules: (TEXT BOX)
Appendix C: Pre-Test

Test given to assess student diagnostic competency as a part of my TAR project (Artifact 3). This version of the test was given before students used the virtual patients and scores were compared to the post-test version to determine change in diagnostic competency attributable to virtual patient use. Each test has questions intended to specifically evaluate the three components of diagnostic competency under the model of Stark et al.: conceptual, strategic, and conditional knowledge.

Conceptual Knowledge (0.5pts each)

1) Stertor localizes disease to which area of the respiratory tract?
   a) Nasopharynx
   b) Upper airway
   c) Lower airway
   d) Pulmonary parenchyma
   e) Pleural space

2) Which of these is the most common cause of viral rhinotracheitis in cats?
   a) Feline panleukopenia virus
   b) Feline coronavirus
   c) Feline leukemia virus
   d) Feline herpesvirus

3) Which of the following features would be unexpected in a dog with brachycephalic airway syndrome?
   a) Stenotic nares
   b) Elongated soft palate
   c) Laryngeal paralysis
   d) Hypoplastic trachea

4) Which antibiotic would be an ineffective choice for treatment of infectious tracheobronchitis?
   a) Doxycycline
   b) Metronidazole
   c) Enrofloxacin
   d) Azithromycin
5) “Tram tracks and donuts” on thoracic films are consistent with which lung pattern?
   a) Alveolar
   b) **Bronchial**
   c) Interstitial
   d) Vascular

6) What type of drug is terbutaline?
   a) **Systemic corticosteroid**
   b) Inhaled corticosteroid
   c) Methylxanthine bronchodilator
   d) **β2-adrenergic agonist bronchodilator**

7) In dogs, bronchopneumonia commonly presents as an alveolar pattern with which distribution?
   a) Cranioventral
   b) Caudodorsal
   c) Perihilar
   d) Random, patchy

8) Which dog breed is predisposed to idiopathic pulmonary fibrosis?
   a) Yorkshire Terrier
   b) **West Highland White Terrier**
   c) Standard Poodle
   d) Border Collie

9) Increased visibility of the ventral border of the trachea on thoracic radiographs is evidence of which disease process?
   a) Pleural effusion
   b) Pneumothorax
   c) Mediastinal mass
   d) **Pneumomediastinum**

10) Which of the following describes the landmarks for thoracocentesis?
    a) Between ribs **4-5, cranial** border of the rib
    b) Between ribs **4-5, caudal** border of the rib
    c) **Between ribs 7-8, cranial border of the rib**
    d) Between ribs **7-8, caudal** border of the rib
Strategic Knowledge (3pts each)

11) A 5 yo MC Boxer is presented to you for a four-month history of sneezing and progressive, right-sided, mucopurulent nasal discharge. The dog has no previous pertinent medical history, no travel history, and is up to date on vaccines and flea/tick/heartworm preventative. What findings should you specifically look for on physical exam?

- Decreases in nasal airflow
- Facial deformity
- Facial pain
- Depigmentation of nasal planum
- Abnormal eye retropulsion
- Dental disease
- Neurologic signs

Rubric:
0 POINTS – no correct answer
1 POINT – 1 correct answer
2 POINTS – 2-3 correct answers
3 POINTS – >=4 correct answers

12) An 8 yo FS domestic shorthair cat is presented to you for acute onset dyspnea. On presentation, her vitals are: heart rate 250 bpm, respiratory rate 80 rpm, temperature 98.9 F.

You hear harsh lung sounds diffusely. Heart sounds as well as all other findings on physical exam are normal. You administer oxygen and then take radiographs. Thoracic radiographs reveal a patchy alveolar pattern. What is your top differential diagnosis for this cat and what treatment would you administer next?

- Congestive heart failure, furosemide

Rubric:
0 POINTS – no correct information
1 POINT – identification of correct treatment, but incorrect diagnosis
2 POINTS – identification of correct diagnosis, but incorrect treatment
3 POINTS – identification of most likely diagnosis and correct treatment
Conditional Knowledge (3pts each)

13) Dr. S.M.R.T. sees a 12 yo MC Shi Tzu for a two-year history of a chronic cough – sometimes dry, sometimes wet. The dog coughs several times a week, but does not appear to be getting worse. On physical exam, the dog has a BCS of 7/9, HR 72 bpm, RR 28 bpm, normal lung sounds, a grade II/VI left, apical, systolic murmur, and no cough elicited on tracheal palpation. Thoracic radiographs show mild left atrial enlargement and a mild bronchointerstitial pattern. Dr. S.M.R.T. prescribes furosemide, but there is no change in clinical signs. Why do you think the dog did not respond to this treatment?

The dog is not in heart failure, other causes for coughing such as chronic bronchitis or bronchomalacia +/- left mainstem bronchial compression should be considered.

Rubric:
0 POINTS – answer does not demonstrate understanding that the dog is not in heart failure
1 POINT – answer demonstrates understanding that the dog is not in heart failure, but does not cite reasons why (normal HR and RR, no pulmonary edema)
2 POINTS – answer demonstrates understanding that the dog is not in heart failure and cites reasons why (normal HR and RR, no pulmonary edema), but does not give alternate diagnoses (lower airway disease)
3 POINTS – answer demonstrates understanding that the dog is not in heart failure, cites reasons why (normal HR and RR, no pulmonary edema), and gives alternate diagnoses (lower airway disease)
14) A 2 yo MC domestic long-hair cat is presented to you for acute onset of tachypnea and respiratory distress. You note that the breathing pattern is short and shallow and confirm the presence of pleural effusion with an abbreviated thoracic ultrasound. You provide supplemental oxygen and perform thoracocentesis; the cat’s breathing improves dramatically. The tap yields 85 ml of a serosanguinous fluid. You check a total protein on the fluid, which is 4.3 g/dl. Why is it important to check a total protein on cavitary effusions?

The total protein helps direct the differential diagnosis – a total protein of 4.3 g/dl indicates the presence of an exudate or modified transudate, increasing suspicion for inflammatory disease.

Rubric:
0 POINTS – answer does not demonstrate any understanding of why a total protein is performed
1 POINT – answer demonstrates understanding that a total protein is an important diagnostic test, but does not qualify the significance of the results
2 POINTS – answer demonstrates understanding that the results of the total protein will narrow/direct the differential diagnosis, but does not give an example of how that information is useful
3 POINTS – answer demonstrates understanding that the results of the total protein will narrow/direct the differential diagnosis and gives an illustrative example
Appendix D: Post-Test

Test given to assess student diagnostic competency as a part of my TAR project (Artifact 3). This version of the test was given after students used the virtual patients and scores were compared to the pre-test version to determine change in diagnostic competency attributable to virtual patient use. Each test has questions intended to specifically evaluate the three components of diagnostic competency under the model of Stark et al.: conceptual, strategic, and conditional knowledge.

Conceptual Knowledge (0.5pts each)

1) Feline calicivirus causes rhinotracheitis, but also can cause ulcers in which location?
   a) Cornea
   b) **Tongue**
   c) Nasal planum
   d) Pinnae

2) What is the most common cause of fungal rhinitis in cats?
   a) **Cryptococcus**
   b) Aspergillus
   c) Histoplasma
   d) Blastomyces

3) What is the most common cause of laryngeal paralysis in dogs?
   a) Myasthenia gravis
   b) Trauma
   c) **Idiopathic**
   d) Intubation

4) Which dog breed is most likely to have tracheal collapse?
   a) **Yorkshire Terrier**
   b) English Bulldog
   c) Labrador Retriever
   d) Great Dane

5) On thoracic auscultation, wheezes generally localize disease to which area of the respiratory tract?
6) What kind of airway inflammation is most commonly seen in canine chronic bronchitis?
   a) **Neutrophilic**
   b) Lymphoplasmacytic
   c) Eosinophilic
   d) Granulomatous

7) Air bronchograms on thoracic films are consistent with which lung pattern?
   a) **Alveolar**
   b) Bronchial
   c) Interstitial
   d) Vascular

8) Cardiogenic pulmonary edema results from changes in which of the following?
   a) Oncotic pressure
   b) **Hydrostatic pressure**
   c) Lymphatic drainage
   d) Vascular permeability

9) Shallow and rapid breathing localizes disease to which area of the respiratory tract?
   a) Nasopharynx
   b) Upper airway
   c) Lower airway
   d) Pulmonary parenchyma
   e) **Pleural space**

10) Which of the following diseases **DOES NOT** cause pleural effusion?
    a) **Canine left-sided congestive heart failure**
    b) Feline left-sided congestive heart failure
    c) Canine right-sided congestive heart failure
    d) Feline right-sided congestive heart failure
**Strategic Knowledge (3 pts each)**

11) A 10 yo MC Labrador retriever presents to you for a 6-month history of intermittent cough and exercise intolerance. On exam, the only abnormalities noted are inspiratory stridor and an increased temperature (103.4 Fahrenheit). The patient's bark has changed and his signs seem to worsen with warm weather. The owners really want a diagnosis, but have limited finances so can only afford one diagnostic test. What is your top differential diagnosis and what test would you perform?

Laryngeal paralysis, sedated laryngeal exam

Rubric:
0 POINTS – no correct information
1 POINT – identification of correct test, but incorrect diagnosis
2 POINTS – identification of correct diagnosis, but incorrect test
3 POINTS – identification of most likely diagnosis and correct test

12) A 3 yo MC Cairn terrier presents to you for coughing that began when the owners picked the dog up from boarding three weeks ago. The dog is eating and drinking normally with normal activity. On physical exam, the cough is dry and elicited upon palpation of the trachea. Lung sounds are normal. The dog has no other pertinent medical history and has been healthy since puppyhood. Based on these findings, you suspect kennel cough. What is your next step?

Empirical treatment with an appropriate antibiotic (doxycycline or azithromycin) or cough suppressant (Hycodan, terbutaline).

Rubric:
0 POINTS – other
1 POINT – empirical treatment with inappropriate drugs
2 POINTS – appropriate (but possibly overzealous) diagnostics – thoracic radiographs, airway wash
3 POINTS – empirical treatment with appropriate drugs
Conditional Knowledge (3pts each)

13) An 8-week-old FI Golden retriever puppy presents to you after chewing an electrical cord. The dog has mild oral ulceration in her mouth, but the rest of her physical exam is unremarkable. She is breathing and acting normally, but you still elect to perform thoracic radiographs. What are you looking for on these radiographs and why?

Electrocution can lead to non-cardiogenic pulmonary, which usually presents as a caudodorsal alveolar pattern in dogs.

Rubric:
0 POINTS – answer does not demonstrate any understanding of why thoracic radiographs are performed
1 POINT – answer identifies the correct radiographic pattern, but not the correct possible diagnosis
2 POINTS – answer identifies correct possible diagnosis, but not the correct radiographic pattern
3 POINTS – answer identifies both the correct possible diagnosis and accompanying radiographic pattern
14) Dr. S.M.R.T. sees a 9 yo MC Siamese cat for a 4-month history of sneezing and bilateral, mucopurulent nasal discharge. Airflow is normal through both nostrils. The cat is otherwise healthy, although seems a little less interested in food lately. Dr. S.M.R.T. treats the cat with a two-week course of amoxicillin/clavulanic acid. The cat initially improves, but clinical signs return soon after finishing the course of antibiotics. Why do you think the cat’s clinical signs recurred?

Primary bacterial rhinitis is very rare in domestic animals. More commonly bacterial infections occur secondary to other nasal diseases such as viral infections, allergic rhinitis or structural disease of the nose. Additionally, amoxicillin/clavulanic acid is not a good choice for possible primary infections of the nose (e.g. Mycoplasma); doxycycline or azithromycin would be a better first choice.

Rubric:
0 POINTS – answer does not demonstrate understanding that amoxicillin/clavulanic acid is unlikely to cure nasal disease
1 POINT – answer demonstrates understanding that amoxicillin/clavulanic acid is unlikely to cure nasal disease, but does not explain why (because primary bacterial rhinitis is rare)
2 POINTS – answer demonstrates understanding that amoxicillin/clavulanic acid is unlikely to cure nasal disease because primary bacterial rhinitis is rare in dogs and cats
3 POINTS – answer demonstrates understanding that amoxicillin/clavulanic acid is unlikely to cure nasal disease because primary bacterial rhinitis is rare in dogs and cats. Additionally, answer demonstrates understanding that other antibiotics (doxycycline, azithromycin) are more appropriate than amoxicillin/clavulanic acid in this situation
Appendix E: Self-Explanation Prompt Worksheet

This is the worksheet that was used by the PROMPT group in my TAR project (Artifact 3). Students were asked to use the worksheet along side the virtual patient modules as a way to explicitly write out their thought processes.

Name:

For each prompt from the module listed below, please complete the requested action.

**Case #1:**

**Prompt 1:** “It’s time to generate a problems list”
List the cat’s problems you have identified from the history and limited physical exam:

**Prompt 2:** “Now we group problems together that may have the same underlying pathology.”
Copy the problems list from the case module. Group together any or all that you believe are due to a common etiology and briefly explain why you grouped them:

**Case #2:**

**Prompt 1:** “It’s time to generate a problems list”
List the cat’s problems you have identified from the history and limited physical exam:

**Prompt 2:** “Now we group problems together that may have the same underlying pathology.”
Copy the problems list from the case module. Group together any or all that you believe are due to a common etiology and briefly explain why you grouped them:

**Prompt 3:** “Now we generate a differential list for inflammatory pleural disease.”
List the large categories of diseases that can cause inflammatory pleural disease. Under each category, list specific etiologies that you believe are possible for this cat:

**Case #3:**

**Prompt 1:** “It’s time to generate a problems list”
List the cat’s problems you have identified from the history and limited physical exam:

**Prompt 2:** “Now we group problems together that may have the same underlying pathology.”
Copy the problems list from the case module. Group together any or all that you believe are due to a common etiology and briefly explain why you grouped them: