

# Iron Pharmacologist: Student Impressions, Satisfaction, and Self-Reported Learning in Response to Active Learning Course Activity in Veterinary

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## Abstract

**Background:** The active learning session is a well-established method to promote deep learning. However, traditional veterinary pharmacology laboratories have been removed from most curriculums. Pharmacology has become a list of therapeutics that encourages rote memorization.

**Aim:** Student attitudes about pharmacology were explored after participation in a novel, student-centered activity.

**Method:** Students participated in a laboratory activity, “Iron Pharmacologist”, that asked teams of students to research and present the answer to individual “secret questions” in a very limited time frame. Immediate verbal feedback was provided to students on accuracy and depth of knowledge, clinical relevance, and presentation style. An anonymous, student-attitudinal survey was administered at the end of each laboratory; this survey was longitudinally administered to subsequent groups over a four-year time frame.

**Results:** Survey results demonstrate high levels of student satisfaction and self-reported learning. Students showed higher levels of performance on external examinations following implementation of this activity.

**Conclusion:** “Iron Pharmacologist” was well received by students, improved performance outcomes, and could be easily adapted for use in other topics.

**Keywords:** *active learning, general pharmacology, laboratory, student-centered*

## Introduction

Active learning teaching techniques increase student retention and retrieval of knowledge (Yardley *et al.*, 2012). In addition, they increase student morale, engagement, and “buy-in” (Gleason, Peeters *et al.*, 2011). However, traditional active learning opportunities (*e.g.* live animal laboratories) in veterinary pharmacology are on the decline since they are resource intensive. Pharmacology educators have replaced these laboratories with paper based activities involving case reports, theoretical clinical cases, and group learning exercises (Darbishire, Plake *et al.*, 2009; Elliott, Koerner *et al.*, 2012; Hidayat, Patel *et al.*, 2012). This threatens to transform veterinary pharmacology into a laundry list of drug classes that students dutifully memorize due to time constraints and lack of enthusiasm. Rote memorization, such as this, is associated with decreased knowledge retention and an inability to apply information in an altered context when compared to active learning techniques (Darbishire *et al.*, 2009).

Veterinary medical education in the United States is a four year post-graduate curriculum similar to other health

professions such as allopathic and osteopathic physicians. Because veterinarians not only prescribe therapeutics, but also dispense them from internal veterinary pharmacies, veterinary pharmacology courses include basic pharmacology, clinical pharmacology, and the basics of veterinary pharmacy. Basic pharmacology is generally encountered during the preclinical curriculum as a single course. Clinical pharmacology is integrated into medicine courses, while veterinary pharmacy is addressed in both preclinical and clinical environments (Willis, 2007). The specific pharmacology curriculum used at Western University of Health Sciences, College of Veterinary Medicine (WesternU-CVM) is beyond the scope of this manuscript and is detailed in the literature (Buur, 2009).

“Iron Pharmacologist” is a student-centered activity designed to help preclinical veterinary professional students with the basic science of veterinary pharmacology. The purpose of this study is to evaluate student attitudes towards “Iron Pharmacologist” and the self-reported learning of pharmacology content.

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## Methods

First and second year veterinary students at WesternU-CVM participated in “Iron Pharmacologist” once during their two year pre-clinical training as a part of the Veterinary Basic and Medical Sciences course (CVM 5000 and CVM 6000). At the end of each laboratory session, students completed a survey about their experience. Survey responses were anonymous and voluntary. The survey was adapted from the validated “Teacher-Designed Feedback Form” technique for assessing learner reactions to instruction and consisted of six questions and an area for free-form comments (Angelo, 1993). The survey items are found in Table I.

### *Iron Pharmacologist Laboratory*

“Iron Pharmacologist” (title coined by the authors) is a laboratory activity based on the television show Iron Chef America™. Students are informed of the laboratory activity and are given a week to gather appropriate resources. Teams of seven students (random group assignments) have 20 minutes to research individual “secret questions” (similar to the secret ingredients from the inspiration television show) and create a sketch to communicate the content to their classmates. Sketches are presented in a randomized fashion. After each sketch, faculty facilitate a class debrief session on important concepts and good resources associated with the specific topic though specific content is not presented by

faculty. However, student presenters receive immediate verbal feedback from faculty on accuracy and depth of knowledge, clinical relevance, and presentation style. Additionally, students vote for the sketch that best illustrated the concept. The winning group displays the perpetual “Iron Pharmacologist Trophy” in their group’s break-out room for the rest of the semester and receives homemade baked goods, courtesy of the faculty. At the end of each laboratory, students are given five minutes of class time to fill out a survey while the instructor leaves the room. Survey items can be found in Table I.

### *Program for the Assessment of Veterinary Education Equivalence (PAVE) Examination*

The PAVE examination is designed to determine the educational equivalence of graduates from foreign universities and universities not recognized by the American Veterinary Medical Association. The exam is a 200 item, multiple-choice test that covers all veterinary species commonly seen in North America. Pharmacology represents 14% of the blueprint. Pharmacology test items include the principles of basic pharmacology as well as clinical pharmacology and veterinary pharmacy (Boards).

At WesternU-CVM, the PAVE is administered to veterinary students at the end of their second year and is 12.5% of their total grade for that semester.

**Table I: Results of attitudinal survey given to students at the end of “Iron Pharmacologist” over the course of four years (2010-2015)**

<b>Graduating Class of</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
<b>Response rate (%)</b>	52/87 (59.8)	81/105 (77.1)	88/98 (89.8)	86/101 (85.2)	85/98 (86.7)	103/105 (98.1)
<b>Topic</b>	Glucocorticoid	Analgesic	Cardiac	PK/TK	PD	PD
<b>Did you learn something new?</b>						
Yes	42 (87.5)	80 (98.8)	83 (94.0)	81 (94.0)	80 (94.1)	99 (96.1)
No	6 (12.5)	1 (1.2)	5 (6.0)	5 (6.0)	5 (5.9)	1 (3.9)
<b>Did you find the questions asked to be (select one)</b>						
Too difficult	5 (10.4)	2 (2.5)	5 (6.0)	23 (27.0)	2 (2.4)	1 (1.0)
Just right	43 (89.6)	79 (97.5)	82 (93.0)	63 (73.0)	78 (91.8)	97 (94.2)
Too easy	0 (0)	0 (0)	0 (0)	0 (0)	4 (4.7)	5 (4.9)
<b>Prior to this session, indicate your knowledge level of the material (select one)</b>						
This was review.	14 (29.8)	19 (23.8)	9 (10.0)	2 (2.0)	14 (16.5)	10 (9.7)
I was familiar with the basic concepts but still confused.	32 (68.1)	54 (67.5)	68 (77.0)	48 (56.0)	70 (82.4)	83 (80.6)
This was all new.	1 (2.1)	7 (8.8)	11 (13.0)	36 (42.0)	1 (1.1)	10 (9.7)
<b>The pace of this session was (select one)</b>						
Too fast	17 (35.4)	41 (51.3)	9 (10.0)	27 (31.0)	7 (8.2)	9 (8.7)
Too slow	4 (8.3)	0 (0)	6 (7.0)	8 (9.0)	5 (5.9)	5 (4.9)
Just right	27 (56.3)	39 (48.8)	69 (78.0)	51 (59.0)	72 (84.7)	89 (86.4)
<b>Did you have fun?</b>						
Yes	40 (90.0)	79 (97.5)	70 (79.0)	72 (84.0)	75 (88.2)	103 (100.0)
No	3 (7.0)	2 (2.5)	13 (15.0)	14 (16.0)	9 (10.6)	0 (0)
<b>Would you want to do this activity again?</b>						
Yes	32 (76.2)	66 (81.5)	68 (68.0)	47 (55.0)	56 (65.9)	96 (93.2)
No	10 (23.8)	15 (18.5)	23 (26.0)	37 (43.0)	26 (30.6)	7 (6.8)

## Results

“Iron Pharmacologist” has been given six times to six different DVM classes over the past five years. Topics have included pharmacokinetics/toxicokinetics, pharmacodynamics, cardiac drugs, analgesics, and glucocorticoids. Each class completed surveys with response rates ranging from 60% to 98%. Self-reported learning (88% to 98%) and positive experiences (70% to 93%) were reported for the majority of classes who completed the survey in each class except for one (Table I). However, that class did report a high (94%) level of learning. Comments gathered from the classes were generally positive. The most common negative comments focused on the time-limit for the research phase and on the student’s preference for lectures rather than activities.

Student performance on the PAVE examination increased from 38% to 50% the first year “Iron Pharmacologist” was implemented and has remained in the 50.1% to 57.4% range (Table II).

**Table II: Overall and pharmacology specific composite scores on the PAVE examination**

Year of Graduation	Overall Score (%)	Pharmacology Score (%)
2009	51.1	38.4
2010*	55.1	50.1
2011	60.2	50.4
2012	62.6	57.4
2013	65.0	53.8
2014	59.1	55.8
2015	56.3	53.6

\* First year that “Iron Pharmacologist” was implemented in the curriculum.

## Discussion

Active learning has proven to increase medical student retention of information in multiple disciplines including biology, engineering, and pharmacology (McLaughlan & Kirkpatrick, 2004; Armbruster, Patel *et al.*, 2009; Gleason, Peeters *et al.*, 2011). While these studies used different techniques to provide an active learning environment, all have cited increased student motivation and engagement as a primary reason for the increase in learning. Kirkpatrick’s model of learning recognizes that attitudes and perceptions about a subject form the basis of learning (Alliger & Janak, 1989). “Iron Pharmacologist” consistently promoted positive student attitudes and self-reported learning in veterinary pharmacology. A single class reported high levels of fun and learning, 84% and 94% respectively, but did not wish to participate in the activity again (43%). This provides evidence that students felt comfortable expressing negative attitudes on the survey.

The PAVE examination scores demonstrated a sustained increase in pharmacology knowledge since the implementation of “Iron Pharmacologist”. The examination is designed to test knowledge after the third year of a

traditional curriculum and is clinically oriented. Our students take this examination after only two years of instruction. Additionally, the PAVE examination comprises 12.5% of the semester grade for veterinary students making the relative risk of not passing this examination substantially less than those graduates of foreign institutions. It is not surprising, then, that students would perform in the 51.5 to 65.0% range as they have only had 66% of the intended education prior to taking the examination and do not have the risk of failing licensure to promote studying. Increase in the overall pharmacology scores cannot be solely attributed to the use of “Iron Pharmacologist”. While the content of the curriculum did not change with respect to the pharmacology content presented, the addition of a faculty member board certified in Veterinary Clinical Pharmacology contributed to multiple learning opportunities besides “Iron Pharmacologist”. However, the increase in scores does suggest that, at best, this activity may increase student motivation to learn pharmacology, and, at worst, does not stifle the learning of this information. More specific testing would need to be done to assess the direct influence of this activity on student retention of pharmacology content.

Topics chosen for this activity were based on the clinical cases presented to the students. Timing of the activity within the curriculum varied based on other curricular activities. Both timing and topic could alter the student responses on the survey. Students would be more likely to report positive experiences if the topic was familiar to them. Conversely, if the laboratory was presented at the end of semester right before summative examinations, students would be highly stressed and this could contribute to negative responses on the survey. Only pharmacodynamics as a topic has been used more than once. The response to that particular laboratory yielded similar self-reported learning (94.1% and 96.1% reported learning something new), but differed with respect to repeating the activity (65.9% and 93.2% reported willingness to repeat the activity).

This activity can be easily adapted to other content without much preparation. “Secret questions” reflecting thought process rather than specific content can be reused by altering the theme of the session. For example, questions relevant to most drug classes, such as how the mechanism of action leads to the major effect of this drug class, can be used no matter which drug class is the focus of the current curricular content. It would be reasonable to expect that this format could be adapted to other basic science disciplines.

Because of the student-centered nature of the activity, “Iron Pharmacologist” allows students to use techniques unique to their own learning style. In our observations, students have used a variety of learning styles including verbal, visual, and kinesthetic during the activity. Cognitive neuroscience has demonstrated that activating more than one area of the brain increases the ability of subjects to recall information (Caine & Caine, 1990). Therefore, we would anticipate that student learning is reinforced beyond that of a traditional lecture. Additionally, students practice collaborative learning and identify reputable resources which are both skills needed to be successful health professionals in a clinical setting (Gleason, Peeters *et al.*, 2011).

All of the classes surveyed reported anxiety about the limited preparation time and a preference for lecture-based delivery of

the content covered. The short preparation time is deliberate. Students are required to develop efficient researching skills of focused questions in order to complete the activity. The desire for a more teacher-centered, passive learning experience reflects student discomfort with activities that promote higher level thought processes. Students synthesize and create new knowledge, which are the highest levels in Bloom's Taxonomy of Learning. These levels are hard to achieve in a traditional lecture environment (Vuchetich, Hamilton *et al.*, 2006).

While the survey used was not specifically validated, it was adapted from a validated survey and face validity was established by the consistency of student responses and the lack of inquiry about the nature of the questions. Validation of the survey for sensitivity would allow for a more thorough investigation of the effects on student motivation. Since the survey was administered immediately after the activity, it is unknown how long increased motivation lasts or if there is any long-term retention of information. Test items for this course are created independent of the laboratory and could not be specifically linked to this activity. Therefore, it is unknown if any specific content was retained by students. Further research focusing on student assessment of laboratory topics is needed to quantitate student learning during this activity.

### Conclusion

"Iron Pharmacologist" represents an active learning laboratory that leads to positive attitudes and self-reported learning. The basic design can be easily adapted to other disciplines. Student objections reflect their desire for passive transfer of large amounts of information and insecurity in their higher level thinking skills. Student performance on an external examination suggests an increase in the motivation to learn pharmacology in general. However, the quantity or quality of specific content retained from this activity is unknown. Future studies looking at the efficacy of this methodology in the teaching specific content are needed.

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