

The Effects of Success-based and Failure-based Case Studies on Veterinary Students'

Real-World Problem-solving Skills

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CHAPTER 1 INTRODUCTION

Rationale

Recently, in the field of veterinary education, a shift of focus from content knowledge to competencies is gradually taking place (Dawson, Miller, Goddard & Miller, 2013). Competencies refer to capabilities that veterinary students acquire to enable them to apply what they have learned in classrooms in practice. By the time they graduate, veterinary students are expected to have the basic knowledge and skills that will allow them to practice veterinary medicine on their own and provide healthcare for a variety of animals (AVEA COE, 2013).

In 2012, the American Veterinary Medical Association Council on Education identified nine core clinical competencies that veterinary graduates should achieve: (a) comprehensive patient diagnosis (problem-solving skills), appropriate use of clinical laboratory testing, and record management; (b) comprehensive treatment planning including patient referral when indicated; (c) anesthesia and pain management, patient welfare; (d) basic surgery skills, experience, and case management; (e) basic medicine skills, experience and case management; (f) emergency and intensive care case management; (g) health promotion, disease prevention/biosecurity, zoonosis, and food safety; (h) client communications and ethical conduct; and (i) critical analysis of new information and research findings relevant to veterinary medicine (AVEA COE, 2013).

The fact that problem-solving skills are ranked as the most important competency indicates the significance of these skills for veterinary students. In this sense, it is well-justified to say that real-world problem-solving skills are critical for

veterinary students to succeed in their future career. So naturally, teaching students how to solve real-world problems should be a primary goal for veterinary education.

However, real-world problem-solving is not easy to teach, especially in formal classroom settings, because most problems covered in classrooms are decontextualized well-structured problems, while problems in real-world contexts are often complex and ill-structured (Tawfik & Jonassen, 2013). To narrow the gap between classrooms and professional contexts, Jonassen (1997) argued that authentic cases experienced by practitioners should be included in the process of instruction to better prepare students for real-world problems. The rationale behind this recommendation is the theory of case-based reasoning (Hernandez-Serrano & Jonassen, 2003), which claims that by observing the problem-solving process carried out by experienced practitioners, students who are in lack of relevant experience may probably learn how to reason and how to come up with appropriate solutions in similar situations and therefore expand their repertoires of experience through others (Kolodner, 1997).

In the past decade, some researchers have conducted research to testify the effectiveness of using cases to promote learning in veterinary contexts (Grauer, Forrester, Shuman & Sanderson, 2008; Krocken, Bosward & Canfield, 2007; Malher, Bareille, Noordhuizen & Seegers, 2009; Patterson, Stickle, Thomas & Scott, 2007; Ramaekers, Beukelen, Kremer, Keulen & Pilot, 2011). They found that although more empirical studies are needed in the field to further validate the value of using cases to teach students how to reason, there are positive results indicating that students benefit

from learning through cases in terms of real-world problem-solving skills.

But most of the cases used in instruction are based on best practices demonstrated by experienced practitioners while they solve real-world problems successfully. Few of them include any mistakes or failures, which are actually inevitable in reality. Here, failure is defined as a gap between what a learner expects or predicts and what he actually perceives (Choi, Kim, Jung, Clinton & Kang, 2006; Shank, 1999). While success-based cases can provide learners with examples to imitate and learn from, mistakes or failures, on the other hand, also represent good opportunities to reflect and learn from. This is clearly indicated by Shank (1999) in his book:

Any learning situation depends upon expectation failure. Expectation failure causes thinking, and our thinking has a great impact on us. To design good learning experiences, we must set up situations in which students can experience expectation failure, can wonder why their expectations failed, and can begin to think something different from what they originally thought. That is what learning is. (p.74)

In 2013, Tawfik and Jonassen carried out an experiment to explore the efficacy of success-based and failure-based cases on students' argumentation skills. Their results showed that failure-based cases promoted students' overall argumentation skills, which are closely related with decision-making and problem-solving skills. These authors suggested that failure could be included in case studies to alert learners of latent problems or pitfalls that may otherwise remain

uncovered in success-based cases. But, if mistakes or failures are to be integrated into instruction in the form of failure-based cases to help students solve real-world problems, more empirical studies are needed to support the effectiveness of this strategy. A key issue that has to be addressed is how mistakes or failures that are included in case studies might differ from best practices demonstrated in success-based cases in their impact on students' real-world problem-solving skills.

Purpose Statement

The purpose of this experimental study will be to compare the influence of success-based cases with that of failure-based cases on real-world problem-solving skills of junior veterinary students from the University of Georgia's Department of Small Animal Medicine and Surgery. The dependent variable of this study is real-world problem-solving skills and the independent variable is the type of cases (success-based or failure-based cases). Generally speaking, real-world problem-solving skills include abilities to define a problem, evaluate alternative solutions based on arguments and evidence, and implement the most feasible solution (Jonassen, 1997). As to success-based and failure-based cases, they differ according to the relative number of errors included in the cases (Ellis & Davidi, 2005). Similar to what is mentioned earlier, errors refer to mismatches between the actual results and the expected outcomes (Allwood, 1984).

To measure the impact of different case types on students' real-world problem-solving skills, students' responses to questions in the final exam specially designed to evaluate their problem-solving skills will be collected for two

experimental groups. The treatment group will participate in a course with case-based learning environment, where they will have access to case studies based on successful experience and the control group will have access to case studies that incorporate mistakes or failures. Both types of cases, with similar contexts, are specially designed to help students learn how to diagnose medical cases based on medical knowledge and existing evidence and propose a treatment plan based on the diagnosis. Besides, interviews or focus groups will be carried out after the exam to explore students' learning experience with different types of case studies.

Research Questions

By analyzing students' opinions on their learning experience and comparing the learning outcome data collected from the exam, the study aims to answer the following research questions:

1. What is students' learning experience with success-based and failure-based case studies?
2. Does a statistically significant difference exist in the effect of success-based and failure-based cases on students' real-world problem-solving skills?
3. If there is a statistically significant difference in the effect of success-based and failure-based cases on students' real-world problem-solving skills, what might be the possible reasons?

Theoretical Framework

The effectiveness of using cases in the process of instruction to develop

students' real-world problem-solving skills is mainly explained by the theory of case-based reasoning, which was originally developed in the early to mid 1980s with the aim of enhancing computer cognition (Kolodner, 1997). The roots of case-based reasoning in the field of artificial intelligence are found in Schank's works on dynamic memory and situation patterns (Aamodt & Plaza, 1994). Besides, the study of analogical reasoning and experiential learning are also believed to have impact on the formation of the theory of case-based reasoning (Aamodt & Plaza, 1994). As to the different effects of success-based and failure-based cases on students' problem-solving skills, the theory of failure-driven memory proposed by Schank is frequently used.

Case-based reasoning is a problem-solving paradigm of using specific knowledge gained from similar previously experienced situations to find solutions to current problems (Aamodt & Plaza, 1994; Slade, 1991). In other words, case-based reasoning means adapting old solutions to address new problems (Kolodner, 1992). According to case-based reasoning, people solve new problems by recalling similar previous experiences and adapting or revising previously employed solutions when necessary to meet the needs of new situations (Aamodt & Plaza, 1994; Slade, 1991). In this sense, by making useful analogical inferences based on past experiences, people are able to identify problems that they need to pay special attention to and accordingly propose appropriate solutions based on the new context (Kolodner, 1997). As a result, in general, solving a problem that one met before is easier than solving a problem that one has never encountered or heard of (Kolodner, 1992).

However, as novices, students are in lack of previous relevant experiences to help them solve real problems they face. To address this problem and educate students equipped to deal with the complexity of real-world situations full of ill-structured problems, case-based reasoning can be applied through a case library learning environment, which includes authentic stories of experienced practitioners solving similar or relevant problems, to enrich or augment students' own experience (Hernandez-Serrano & Jonassen, 2003; Jonassen, 1997; Jonassen & Hernandez-Serrano, 2002), so students are able to reason beyond what they could do otherwise based on cases indexed into their own memory (Kolodner, 1997). In other words, case-based reasoning in the form of a case library learning environment may help students contextualize the content knowledge they learn and understand how to apply it in practice to solve real world problems (Tawfik & Jonassen, 2013).

While it is easy to assume that cases representing the best practices carried out by experienced practitioners are the most effective to help students construct mental models for real world problem solving (Tawfik & Jonassen, 2013), Shank's (1999) theory of failure-driven memory suggests that failures provide better chances to learn. According to Shank (1999), learning is all about memory modification triggered by failed prediction and any learning situation depends upon expectation failure, because when people experience expectation failure, they will wonder why their expectations failed, and then begin to think something different from what they originally thought. That is when learning actually occurs.

Based on this theory, it is assumed that students may probably learn better in

terms of real-world problem-solving skills if they experience some expectation failures through failure-based cases during the learning process, compared with success-based cases that demonstrate best practices, because failures may force the students to reflect upon breakdowns, stimulate further inquiry to explain the failures and internalize a more comprehensive mental model of the problem they face with additional indices generated by failures (Tawfik & Jonassen, 2013).

Importance of Study

The current study of the effects of success-based and failure-based case studies on veterinary students' real-world problem-solving skills is significant for several reasons. First of all, understanding the different effects of success-based and failure-based case studies on veterinary students' real-world problem solving skills can help instructional designers explore more effective instructional strategies to enhance students' problem-solving skills and prepare them for future career. If better instructional strategies are indentified based on the findings of this study, students will be more likely to acquire the competencies that enable them to practice veterinary medicine by the time they graduate. Accordingly, with veterinary graduates being more competent in terms of solving real problems, patients as well as their owners will benefit by receiving better treatment.

Second, apart from the field of veterinary medicine, the findings of the study have the potential to promote learning in other fields where learning to solve problems, especially ill-structured real-world problems, is their major focus, like instructional design (Jonassen, 1997), environment protection (Jonassen, 1997),

anesthesiology (Choi, Kim, Jung, Clinton, & Kang, 2009) and classroom management (Choi & Lee, 2009). If the findings of this study validate that a certain type of case studies is more effective to help veterinary students develop real-world problem-solving skills, similar approach is also likely to be applied to other fields to help students in general to become better problem solvers.

Third, although the theory of case-based reasoning, which describes that learning to solve complex problems results from experiencing similar problems (Kolodner, 1997), is proposed decades ago, very limited empirical studies exist as to the most effective instructional designs that help to develop students' real-world problem-solving skills through the use of case studies (Tawfik & Jonassen, 2013). Since apart from successful problem-solving experiences, failures also represent an integral part of everyday practice, more empirical studies are needed to explore how failures included in case studies might differ from best practices demonstrated in success-based case studies in their impact on students' real-world problem-solving skills.

Last but not the least, most of the current literature on learning from failures is in the context of training in work place rather than classrooms, therefore, this study might contribute to literature related to learning from failures in traditional classroom contexts.

References

- Aamodt, A., & Plaza, E. (1994). Case-based reasoning: Foundational issues, methodological variations, and system approaches. *Artificial Intelligence Communications*, 7(1), 39-59.
- Allwood, C. M. (1984). Error detection processes in statistical problem solving. *Cognitive Science*, 8(4), 413-437.
- Choi, I., Kim, H., Jung, J. W., Clinton, G., & Kang, J. (2006). A case-based e-learning model for professional education: Anesthesiology for dental students. *Educational Media and Technology Yearbook*, 27, 109-118.
- Choi, I., & Lee, K. (2009). Designing and implementing a case-based learning environment for enhancing ill-structured problem solving: Classroom management problems for prospective teachers. *Educational Technology Research and Development*, 57(1), 99-129. doi:10.1007/s11423-008-9089-2
- COE Accreditation Policies and Procedures: Requirements. (2012). Retrieved September 30, 2013, from American Veterinary Medical Association Council on Education website, <https://www.avma.org/ProfessionalDevelopment/Education/Accreditation/Collages/Pages/coe-pp-requirements-of-accredited-college.aspx>
- Dawson, S. D., Miller, T., Goddard, T. F., & Miller, L. M. (2013). Impact of outcome-based assessment on student learning and faculty instructional practices. *Journal of Veterinary Medical Education*, 40(2), 128-138. doi: 10.3138/jvme.1112-100R

- Ellis, S., & Davidi, I. (2005). After-event reviews: Drawing lessons from successful and failed experience. *Journal of Applied Psychology*, 90(5), 857-871. doi: 10.1037/0021-9010.90.5.857
- Grauer, G. F., Forrester, S. D., Shuman, C., & Sanderson, M. W. (2008). Comparison of student performance after lecture-based and case-based/problem-based teaching in a large group. *Journal of Veterinary Medical Education*, 35(2), 310-317.
- Hernandez-Serrano, J., & Jonassen, D.H. (2003). The effects of case libraries on problem solving. *Journal of Computer Assisted Learning*, 19, 103-114.
- Jonassen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research and Development*, 45(1), 65-94.
- Jonassen, D. H., & Hernandez-Serrano, J. (2002). Case-based reasoning and instructional design: Using stories to support problem solving. *Educational Technology Research and Development*, 50(2), 65-77.
- Kolodner, J. L. (1992). An introduction to case-based reasoning. *Artificial Intelligence Review*, 6(1), 3-34. doi:10.1007/BF00155578
- Kolodner, J. L. (1997). Educational implications of Analogy — a view from case based reasoning. *American Psychologist*, 52(1), 57-66.
- Krocken, M. B., Bosward, K. L., & Canfield, P. J. (2007). Integrated case-based applied pathology (ICAP): A diagnostic-approach model for the learning and teaching of veterinary pathology. *Journal of Veterinary Medical Education*,

34(4), 396-408.

Malher, X., Bareille, N., Noordhuizen, J. P. T. M., & Seegers, H. (2009). A case-based learning approach for teaching undergraduate veterinary students about dairy herd health consultancy issues. *Journal of Veterinary Medical Education*, 36(1), 22-29.

Patterson, J. S., Stickle, J. E., Thomas, J. S., & Scott, M. A. (2007). An integrative and case-based approach to the teaching of general and systemic pathology. *Journal of Veterinary Medical Education*, 34(4), 409-415.

Ramaekers, S. P. J., Beukelen, P. V., Kremer, W. D. J., Keulen, H. V., & Pilot, A. (2011). An instructional model for training competence in solving clinical problems. *Journal of Veterinary Medical Education*, 38(4), 360-372. doi: 10.3138/jvme.38.4.360

Schank, R. (1999). *Dynamic memory revisited* (2nd ed.). Cambridge, England: Cambridge University Press.

Slade, S. (1991). Case-based reasoning: A research paradigm. *AI Magazine*, 12(1), 42-55.

Tawfik, A., & Jonassen, D.H. (2013). The effects of successful versus failure-based cases on argumentation while solving decision-making problems. *Educational Technology Research and Development*, 61(3), 385-406.
doi:10.1007/s11423-013-9294-5